

**ENERGY CONSUMPTION BEHAVIOR IN THE COMMERCIAL SECTOR:
AN ETHNOGRAPHIC ANALYSIS OF UTILITY BILL INFORMATION AND
CUSTOMER COMPREHENSION IN THE WORKPLACE**

by

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The most exciting phrase to hear in science, the one that heralds new discoveries, is not 'Eureka!' (I found it!) but 'That's funny...'

Isaac Azimov

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ABSTRACT

The commercial and industrial sectors of the United States compose roughly one-third of total United States energy consumption. Many studies have suggested that significant cost-effective energy savings opportunities exist in this sector, but there is a gap between predictions of potential and actual investment in energy-efficient technologies. Very few studies have been conducted to examine the decision-making environment of the business sector. In particular, there is essentially no information about how small-business decision-makers make choices about energy consumption. My research is intended to begin the process of understanding this important arena of energy consumption behavior.

Using semi-structured interview techniques, I interviewed forty-four businesses in ten states. The focus of the interviews was the business decision-maker's handling and use of the utility bill — the main (often sole) piece of information that links energy consumption to cost. Through the interviews, I collected information about how utility bills are understood and misunderstood, what components of the bill are seen as useful or confusing, and how energy consumption was seen in the context of larger business decision-making.

In addition, I collected data on two forms of energy consumption feedback: historic consumption feedback, in which informants compared their current

energy use to patterns of their own energy consumption over time; and group comparison consumption feedback, in which informants compared their energy consumption to the consumption of a group of similar energy consumers. Finally, I collected data on sources of information to which decision-makers turned when they wanted to seek more information about energy consumption alternatives.

Overall, my findings suggest that the current utility bill format is often misunderstood. In many cases, particularly in the small-business and medium-size-business categories, the link between energy consumption and energy cost is broken. The result is a sense of disempowerment for many consumers. Rather than seeing their energy consumption as something under their control, they instead view the energy bill as an unavoidable component of operating a business, comparing it to other required expenses like rent or taxes.

Reaction to changes in the utility bill to provide consumption feedback were mixed. Improvements to self-comparison information provided on the bill were generally viewed positively. On the other hand, energy consumption comparisons with similar groups of customers were viewed with a great deal of skepticism. The idea of group comparison was generally discarded as impractical or invalid.

This research improves academic understanding of the energy consumption decision-making environment in the business sector. By developing a better understanding of the context in which these energy consumption decisions are made, the research suggests opportunities for improvements to the

mechanisms by which business decision-makers gain information about energy consumption alternatives and energy efficiency opportunities. Improvements to the information provided on the utility bill could enhance the linkage between energy consumption and energy cost for commercial-sector decision-makers, particularly in the small business sector. This could, in turn, lead to greater attention to economic opportunities for energy consumption reduction. Ultimately, improved utility bill information could result in energy and cost savings to business consumers.

Chapter 1

INTRODUCTION

In this chapter, I give a brief introduction to energy consumption in the United States, review the policy implications of this consumption, focus more precisely on the topic of energy consumption in small businesses, and outline the need for research to better understand this area. I then present the organization of the rest of this document.

In 2004, the United States consumed almost 100 quadrillion BTUs of energy, approximately 25% of the world's total consumption (EIA 2005a). This consumption was divided roughly evenly among three sectors: residential and commercial, industrial, and transportation. On a per-capita basis, the United States consumed roughly twice as much energy as either Germany or Japan, seven times as much energy as Brazil, ten times more energy than China, and twenty-six times more energy than India (EIA 2005b).

1.1 Policy Implications of Energy Consumption

There are a number of policy implications resulting from this high level of energy consumption. Because the United States consumes more energy than it can produce, it must import energy (primarily crude oil) from other countries. The purchase of those imports contributes significantly to the United States

trade deficit, now at record highs. Domestically, the purchase of energy is a significant cost to consumers; the United States Department of Energy's Energy Information Administration (EIA) estimates that consumers paid \$694 billion in 2001 for energy (EIA 2005a). In 2005, oil and natural gas prices have increased significantly.

As unrest in the Middle East has amply demonstrated, the requirement for oil imports also has national security implications. The United States must protect its ability to acquire its energy imports. In addition, the use of nuclear power to generate electricity raises the issue of fissile material proliferation. For example, the United States is investing billions in securing material from nuclear facilities in the former Soviet Union (GAO 2000).

Finally, the conversion of raw fuels to useful energy services creates a wide variety of environmental problems. There are significant environmental impacts at every stage of the process, from the soil erosion caused by strip mining and hazardous tailings associated with mining coal or uranium; to the oil spills, gas leaks, etc. associated with transporting oil and gas; to the sulfur, nitrogen, particulate, and heavy metal emissions associated with burning fossil fuels; to the hazardous ash and radioactive waste left behind when fossil or nuclear fuels are consumed.

The greatest environmental problem due to fossil-fuel consumption is the potential for global climate change as a result of the sharp increase in CO₂ levels in the atmosphere. Global climate change has the potential to significantly alter

ecosystems worldwide, with unclear but likely significant negative impacts on human well-being.

1.2 Policy Responses to Energy Consumption Impacts

What have been the policy responses to this wide range of implications associated with energy consumption? They can be broken into three components: development of energy supplies, mitigation of environmental impacts, and reduction of energy demand through improved efficiency of energy use.

Federal policy initiatives to improve energy efficiency in the commercial sector have primarily used economic principles as their operating guidelines. In general, it has been assumed by policy-makers that businesses will act in economically rational ways to reduce their energy costs. Since investment in energy-efficient technologies is generally a high-yield prospect in economic terms (i.e., there are many energy-saving opportunities for which the value of energy savings is greater than the amortized cost of the technology), the assumption has been that businesses will act to reduce their energy consumption in this way.

There have been three main policy themes within this economic approach: development of energy-efficient technologies; dissemination of information about energy efficiency investment opportunities; and provision of economic subsidies for the purchase of energy-efficient equipment.

The first response—developing more efficient technologies—is based upon the assumption that businesses will choose to invest in new technologies if they can be shown that the benefits of the new technology outweigh the old. Federal investment in research and development has stimulated the development of several efficient technologies, including the compact fluorescent lamp, electronic ballasts, and energy efficient windows (Lawrence Berkeley National Laboratory 1995). By continuing to fund research to develop new technologies, the federal government hopes to provide a supply of energy-efficient technologies from which consumers can choose.

The second federal policy response—information dissemination—has involved the development of advertisement campaigns, Web sites, voluntary labeling programs, and other means to make energy-efficient technologies more visible in the marketplace. Again, the assumption is that businesses will adopt new technologies if they are cost-effective in comparison to older systems. Information campaigns are meant to provide the necessary data to end users to enable them to realize the cost-effectiveness of these new technologies. Implicit in this response is the idea that the market cannot provide that information during the initial stages of a new product's deployment.

Finally, the third approach—economic subsidies—is based upon the assumption that businesses make economically rational decisions based upon perfect information. In the absence of private-sector investment in energy-efficient products, the implication is taken that the first cost of the products must be the investment obstacle. Subsidies reduce this first cost, making investment in energy-efficient technologies more attractive. While experience has shown

that subsidies are effective in increasing investment in these technologies, the subsidies are often extraordinarily expensive for the results achieved.

All of these policy initiatives have had limited effectiveness. Businesses have been slow to react to energy efficiency investment opportunities. This has left a significant difference between the potential cost-effective energy savings estimated by some energy analysts and the actual adoption of new energy-efficient technologies by business. This difference has been labeled the “efficiency gap.” (See, e.g., Hirst and Brown 1990; Levine et al. 1994.)

1.3 “Businesses” vs. “Buildings” or “Commercial and Industrial Sector”

One reason for this gap between analyst expectations and market reality might be that the energy policy research community has let a significant area of energy consumption research go unexamined. Within analysis of commercial energy consumption, energy policy researchers have essentially forgotten the business decision-maker. Researchers typically do not even discuss businesses – the unit of analysis is usually the “commercial sector” or “commercial buildings.” But the commercial sector is made up of people, and the energy policy research community knows very little about how those people behave in their business environment.

It is not surprising that this is the case, for several reasons. For one thing, businesses fall into a gray area in United States energy policy. There are two main areas of commercial sector research: the buildings sector, and the commercial and industrial sector. On the buildings side, commercial

establishments are often lumped together with residences within the unit of analysis “buildings.” Furthermore, within that grouping commercial buildings are quite often assumed to be office buildings. Within these buildings, the main energy consumption is from lighting, HVAC systems, and plug loads. As a result, policies to deal with reducing commercial energy consumption often focus on changing the design and construction of office buildings.

Within the area of analysis labeled commercial and industrial, the business is usually considered to be a large organizational structure. The barriers to improving energy efficiency are therefore often seen as problems with information flow within the organization, as well as a lack of harmony between organizational goals and energy efficiency improvements. Several studies have documented these problems of organizational complexity. (See, e.g., Cebon 1990, 1992b, 1993; DeCanio 1998; DeCanio and Watkins 1998.)

Thus, on the one hand, analysis of the commercial sector results in the assumption of large businesses; and on the other hand, analysis of the buildings sector results in the assumption of office buildings. Neither of these assumptions seem appropriate for retail establishments, nor are the results of these analyses directly applicable to improving the efficiency of operations in the small commercial case. Small businesses have few employees and do not suffer from the organizational communication problems of larger firms. Small businesses also do not typically occupy office buildings. In fact, it is often the case that several businesses occupy the same building. It is this under-examined area of small business energy decision-making into which I wish to extend analysis.

1.4 Commercial Sector and Small Businesses

The Energy Information Administration defines the commercial sector as “An energy-consuming sector that consists of service-providing facilities and equipment of: businesses; Federal, State, and local governments; and other private and public organizations, such as religious, social, or fraternal groups” (EIA 2006). This sector accounts for approximately seventeen percent of total energy use in the United States, consuming roughly 17.5 quadrillion BTUs of source energy in 2004. Most of that consumption was of electricity, with the majority of the remainder natural gas. The cost of this consumption was roughly \$126 billion dollars in 2001 (EIA 2005a).

Energy Information Administration data shows that commercial buildings in the United States are smaller in floor area than one might expect: “The vast majority of buildings were found in the smallest size categories, with more than half (52 percent) in the smallest category (1,001 to 5,000 square feet) and three-quarters in the two smallest categories (1,001 to 10,000 square feet)” (EIA 1995, 9).

Why is it that this area of analysis needs to be extended? What is wrong with concentrating on large office buildings or large companies? Data from the United States Small Business Administration (SBA) suggests that small businesses have a larger impact nationwide than one might expect (SBA 1994):

1. 90% of the businesses in the United States are small businesses.
2. Small businesses are responsible for 39 percent of GNP.

3. Small businesses employ 54.4 million people, about 57.3 percent of the private workforce.

1.5 Need for Analysis

As mentioned previously, the “efficiency gap” has been a focus of debate in commercial sector energy policy analysis. While some authors have argued that consumers are acting irrationally by not adopting these technologies, others have argued that there are various “market barriers” that make it a rational choice to forgo investment in new technologies; cf., Hirst and Brown 1990; Howarth and Sanstad 1995; Jaffe and Stavins 1994; Levine et al. 1994; Sanstad and Howarth 1994; Sutherland 1994.

While there has been some acceptance that economic theory may need augmentation with other approaches to explain energy consumption in the residential sector, the idea that commercial and industrial consumers of energy should be treated as anything other than rational economic actors has been slow to be accepted by the energy policy research community. Two authors have suggested that research into the behavior of individuals acting in the commercial and industrial sector is necessary. Responding to unexpected complexity in the monitoring of commercial building energy consumption, Bailey is quoted as saying, “Never underestimate the power of building owners or occupants” (Electrical World 1991, 26). In an opinion piece in *Energy Policy*, Hichcliffe writes:

In conclusion it is perhaps time for policy makers to listen to what various groups of people have to say about energy options

– they are, after all, the people who might buy/use, or ignore/reject information of new products, and in doing so shape the future of energy policy. [Hinchcliffe 1995, 94]

So, why has little of this research been done?

In his review of the socio-behavioral energy literature, Lutzenhiser (1993) pointed to the existence of a particular research/policy paradigm that constrains the analysis of energy consumption: “a physical-technical-economic model (PTEM) of consumption dominates energy analysis, particularly in energy demand forecasting and policy planning” (Lutzenhiser 1993, 248). Lutzenhiser (1993) identified a significant body of literature, but noted of his review, “Its primary focus is on household consumption—the area where most behavioral research has concentrated” (Lutzenhiser 1993, 248). Lutzenhiser (1993) argues that this PTEM makes three assumptions:

1. Energy consumption can be understood by analysis of the physical characteristics of energy consuming technologies in a particular sector; e.g., the characteristics of the building envelope, the space conditioning system, and the appliance mix in residential construction;
2. Technical changes to those systems can reduce energy consumption; e.g., through improved wall and ceiling insulation, more efficient furnace systems, and appliance standards to improve appliance efficiency; and
3. Decision makers will adopt the mix of energy consuming technologies that is most cost-effective; e.g., a home owner will purchase a more efficient furnace if the cost of the furnace will be recouped in lower operating costs.

Lutzenhiser (1993) argues that human social behavior has been largely overlooked as a descriptor of energy consumption; however, as he

acknowledges, the majority of this type of research has focused on the household, with some secondary analysis of macro-social issues.

This research on which this dissertation is based examines an area of energy policy that has been largely neglected: the energy consumption decision-making process of business decision-makers. While there has been a fair amount of research into the energy choices that residential customers make, very little has been done in the commercial sector.

1.6 Dissertation Outline

The remaining chapters of my dissertation are organized as follows:

1.6.1 Background – Review of Behavioral Literature

This section provides four main arguments: one, that energy policy as currently practiced in the commercial sector is heavily oriented toward a reliance on economic theory as a predictor of energy consumption behavior; two, that such a reliance is ineffective; three, that behavioral analysis can contribute significantly to more effectively achieving energy policy goals; and four, that energy consumption feedback can be a useful policy tool to reduce energy consumption. As mentioned previously, the behavioral research on energy consumption within the commercial sector is quite sparse. Therefore, this section reviews several residential behavioral studies and identifies the benefits of and barriers to affecting consumption behavior through the provision of information.

Narrowing the focus from the broad scope of changing behavior through provision of information, this section examines the specifics of energy consumption feedback. In particular, this section shows why consumption feedback is an effective subset of information provision in general; why the commercial sector is an interesting area to study the impact of consumption feedback on energy consumption decision-making; why the utility bill is the primary consumption feedback tool; and why alternatives to current practice are likely to provide energy consumption reduction. This argument is based on the few commercial-sector studies that have been conducted, extrapolation from the residential sector literature, and my own experience in researching or implementing consumption feedback mechanisms (e.g., Energy Star Billing, the Energy Guide label, and the GSA “Second Price Tag” pilot program.)

1.6.2 Method – Interviewing Business Owners

This section describes the semi-structured interview method as an appropriate tool for research in this environment, the process used in choosing informants, the development of interview protocols, and the data analysis method.

1.6.3 Analysis – Findings from Interviews

Drawing on the data from my interviews, I demonstrate the existence of common decision-making practices among small commercial customers about their energy consumption. I discuss the effectiveness of current utility bills as a means of providing information relevant to these decision-making practices. I discuss the response of commercial consumers to alternative information

displays of energy consumption. Finally, I discuss sources of information business decision-makers use to make energy consumption choices.

1.6.4 Conclusion – Recommendations for Feedback Improvement

Based on my analysis, I provide specific policy recommendations for

1. improvements in current utility bill design,
2. improvements in the targeting of specific information to specific commercial customers,
3. opportunities for new information dissemination mechanisms, and
4. further research areas of value.

Chapter 2

BACKGROUND

What does the existing literature have to say about energy consumption decision making in the commercial sector? There are two areas of discussion from which to draw: literature about commercial sector investment in energy-efficient technologies, and literature that deals generally with energy consumption behavior. There is residential sector literature on energy consumption behavior, and there is commercial sector literature on investment practices. The two have essentially no overlap. It is this gap that this dissertation addresses.

In the commercial sector, the main approach has been one of descriptions of the economics of business investment practices. As we will see, these descriptions have often proceeded with little primary data on the expressed decision-making practices of the business in question. Instead, the analysis has been conducted by inferring decision-making models from macro-level data about technology adoption. Very little is known about how individual decision makers in the commercial sector environment describe their own energy consumption practices.

By comparison, there is a rich literature describing the energy consumption behavior of individuals in the residential sector. In fact, the general consensus of the analytical community suggests that it is very difficult to describe residential

energy consumers using the standard analytical techniques of classical economics.

At the same time, though, there is not a lot of data on the impact of multiple actors in a decision-making context on energy consumption. Residential sector energy studies have generally treated the homeowner as a single decision maker. The commercial sector often has multiple actors playing a role in the energy consumption of the business. As a result, the applicability of the lessons learned in the residential sector to analysis of the commercial sector is unclear.

Each of these literature topics is discussed in turn below. By understanding the missing elements of both spheres of analysis (residential and commercial), I hope to be able to “bridge the gap” between the two and develop an understanding of small business energy consumption informed by primary data from business consumers.

2.1 Commercial Sector Investment in Energy Efficiency

One strong theme running through publications on commercial sector energy policy is the idea of an “efficiency gap.” Hirst and Brown seem to have been the first to use this term in print when they titled their 1990 journal article *Closing the efficiency gap: barriers to the efficient use of energy*. In that article, they define the gap this way:

For a variety of reasons, households, businesses, manufacturers, and government agencies all fail to take full advantage of cost-effective, energy-conserving opportunities. The result is a

significant gap between the current and optimum levels of energy efficiency. [Hirst and Brown 1990, 267]

More precisely, the efficiency gap is the difference between technical predictions of cost-effective energy efficiency technology options and the observed implementation of those technologies. Hirst and Brown (1990) write that for energy efficiency improvements in the United States, “[O]nly half of the total potential is likely to be achieved unless government policies are changed” (Hirst and Brown 1990, 269). They argue that the opportunity to achieve this energy efficiency improvement potential is blocked by a number of structural and market barriers. Structural barriers include elements such as artificial pricing of energy, limited access to capital, and supply infrastructure limitations. My research interest is in the perceptions and motivations of small business consumers. As these structural barriers are beyond the control of the energy consumer, I choose not to consider them in my study. Market barriers, on the other hand, are issues with which the commercial consumer has direct connection. Hirst and Brown (1990) list four market barriers that inhibit the ability of the individual to make a cost-effective decision about energy consumption:

1. attitudes toward energy efficiency,
2. perceived risk of energy investment,
3. information gaps, and
4. misplaced incentives.

Hirst and Brown (1990) recommend several policy responses to overcome these barriers. They conclude, however, that more research is necessary “...to understand barriers, to assess their importance sector by sector, and to examine

the effectiveness of policy options that might overcome them” (Hirst and Brown 1990, 278). Specifically of interest to my research, they recommend that future work include “field tests to improve understanding of how end-users make energy-related decisions” (Hirst and Brown 1990, 279).

2.2 Analysis of Commercial Sector Energy Investment

The discussion of this efficiency gap generated several publications in response. These publications are dominated by economic discussions of the nature of this identified gap and generally fall into two camps: neoclassical economics, and institutional or behavioral economics. Several publications have summarized this literature, including Kulakowski (1998) and Golove and Eto (1996).

2.2.1 Neoclassical Economics

The neoclassical economics perspective argues that businesses do not forego profitable investments. If businesses are not investing in technologies to reduce energy consumption, the technology options available must not be cost-effective. The cause of the “efficiency gap” is, therefore, an error in the predictions made of cost-effective technologies available for investment. In this view, the predictions do not take into account hidden costs to the businesses of investment in the efficient technologies. If those costs are taken into account, the potential for cost-effective efficiency improvement is reduced, and the difference between predicted and actual investment behavior is eliminated. For example, Sutherland (1991) argues that investment in energy-efficient technologies involves a degree of risk. Since there are not good methods for

businesses to mitigate that risk, they choose to forgo investment. Hassett and Metcalf (1993) and Metcalf (1994) argue that the purchase of an energy efficient technology requires a commitment to the technology for the life of the product. Since there is no secondary market for energy technologies (e.g., a “used chiller” market), investing in energy efficiency locks the investor into a long-term investment with uncertain returns. This illiquidity of the investment option, in turn, makes the necessary return on investment higher and the cost-effectiveness ratio lower; ergo, lower investment in energy technologies.

2.2.2 Behavioral/Institutional Economics

The “behavioral economics” or “institutional economics” perspective relaxes some of the assumptions of the neoclassical school about market conditions and decision-maker rationality. In this view, several market barriers exist to investment in energy efficient technologies. Howarth and Sanstad (1995), for example, argue that “asymmetric information, bounded rationality, and transaction costs are major contributors to the so-called ‘efficiency gap.’” These are all forms of market action based on imperfect information - a major feature of the behavioral economics school. Neoclassical economics generally assumes that decision makers are aware of the cost of energy consumption and the availability of technologies to affect that consumption. Behavioral economics, in contrast, argues that firms must make do with incomplete information and develop ways to deal with this. An example of a mechanism to deal with incomplete information is “satisficing,” in which a decision maker chooses not the best option of the universe of options available but rather the first option that satisfies the requirements necessary to meet the particular issue at hand.

(See, e.g., Simon (1987) for a discussion of satisficing.) In this way, decisions are not optimal in a rational utility maximization sense, but they are satisfactory for continued operation of the business.

Golove and Eto (1996) summarize three other market failures:

1. externalities, particularly environmental externalities associated with energy production;
2. imperfect competition, such as the consolidation of technology production in the hands of a few firms; and
3. public goods, in which later market players benefit from the decisions made by earlier decision-makers, reducing the benefit to the early decision-maker.

Public goods barriers exist for both buyers and sellers of products.

Manufacturers may choose to forego production of efficient technologies if they believe that investments in basic research may not be fully recoverable because the information generated cannot be fully protected. Buyers may choose to forego purchasing an untested product, as the risk associated with early adoption of a technology is not borne by later adopters, yet the value of early adoption may not compensate the risk taken.

Much of the discussion about market failures then devolves into discussion of the proper role of government policies in intervening in energy markets. (Golove and Eto (1996) go to some length to identify and avoid this confluence of analysis and policy implication.)

The problem I identify with either the neoclassical or the behavioral/institutional perspective is that each is very “top-down” driven. Each looks at macro-level behavior of the commercial sector and makes conclusions about the cause of that behavior. Neither addresses issues of how individual actors are behaving in the marketplace. I believe that analysis of commercial-sector energy consumption behavior would be more effective if the analysis used data from individual consumers and built from this base of data up to a theoretical framework that was informed by the data – a “bottom-up” development of theory rather than a “top-down” imposition. The lack of “bottom-up” data gives both the neoclassical and the behavioral/institutional economic frameworks an incomplete view of the energy consumption decision-making process.

Another major issue I see as problematic with both of these perspectives is that they tend to treat firms as black boxes generating a unique decision about energy consumption and energy technology investment. A more recent set of literature using a different set of analytical methods seeks to open this black box.

2.2.3 Organization Theory

Organization theory looks more closely inside the business to examine the decision-making process as the outcome of a set of interactions among organizational members. In a review of the development of organizational analysis, Scott (1998) writes, “Most analysts have conceived of organizations *as social structures created by individuals to support the collaborative pursuit of specific goals*” (Scott 1998, 10; emphasis original.) In this type of analysis,

generally known as organizational analysis or organization theory, businesses are made up of various individuals who provide specialized skills necessary for the proper, efficient function of the business. The actions of the business are governed by the collective action of these individuals.

Some researchers have used organization theory to analyze commercial sector energy consumption. Ross (1986), for example, argues that the internal process of budgeting for energy efficiency investment leads to high requirements for return on investment and overly simplistic economic decision criteria to determine choices among investment options. Cebon 1990, 1992a, 1992b, 1993 and Kulakowski (1998) have investigated the sociology of internal firm actors to identify additional barriers to energy efficiency investment in firms. In their analyses, issues of inter-group communication, information flow, task assignment, etc. determine corporate actions. The efficiency gap is therefore described as a result of barriers within the organization to a corporate decision of energy efficiency. Examples include:

1. the lack of prestige afforded energy managers within a firm and therefore the discounting of their recommendations when compared with other business options;
2. lack of information flow between employees responsible for paying utility bills and employees responsible for operating energy-consuming equipment, therefore eliminating the price signal necessary for appropriate market response; and
3. problems with allocation of financial resources between operating budgets (which pay the utility bills) and capital budgets (which would be used to invest in new energy-efficient technologies).

More recently, DeCanio (1998) and DeCanio and Watkins (1998) have found that firm characteristics play a role in determining the level of efficiency investment undertaken. DeCanio (1998) concludes, "...organizational and institutional factors are important determinants of firms' investment behavior and outcomes. While economic forces also play a role, economics alone cannot explain either the level of or the variation in returns..." (DeCanio 1998, 453).

Lutzenhiser et al. (2002) use an approach informed by organization theory to analyze commercial and institutional response to the California energy crisis of 2001. In examining the actions firms took to react to the energy crisis, they identified the need for a new model to describe how and when organizations act. This view recognized that the context in which firms operate is a key determinant of firm behavior:

...this model is an alternative to the **market barriers view**. It recognizes the internal dynamics of organizations and the conditions they face. It suggests that programs should focus on organizational concerns, conditions, and capacity rather than market barriers. [Lutzenhiser et al. 2002, ix-x; emphasis original]

A comparison of these three models of commercial sector analysis (neo-classical economics, behavioral economics, and organizational analysis) shows that they seem to move from a view of "business as black box" (the neo-classical model) to looking inside the box to see what is happening. As noted previously, this "black box" view has been a weakness with the bulk of commercial energy studies, which fall largely in the neo-classical or behavioral economics realm—the studies rarely ask why people within these businesses

are behaving the way they do. Looking inside the box is critical because it reveals the variables that could be subject to policy intervention of support.

This is not a shortcoming that is completely overlooked by those involved in the debate. Sanstad, for example, has expressed to me in e-mail correspondence the need for more research in this area, writing:

Few if any [papers in the literature] report on *actually going out and looking* [original emphasis] at what people do and don't do, and why. Suffice it to say that both engineers and economists have been guilty of a good deal of not-particularly-well-grounded speculation on this point.

Rather than go out and gather data from commercial customers themselves about how they make energy consumption choices, analysts of the commercial sector have instead argued over the proper factors to include in the a priori models of commercial sector investment decisions. What is it that drives the behavior of decision-makers within firms? What do they say they use to make their choices? This kind of behavioral research is almost completely missing in the commercial sector. It has, though, been done in the residential sector. What can we learn about behavior in the small business sector from the behavioral research that has taken place in the residential sector?

2.3 Changing Consumption Behavior

One thing that is striking about the difference between residential sector and commercial sector literature is the presence in the residential sector literature of explicit intent to change consumption behavior. While the commercial

sector literature reviewed above primarily discusses inferred descriptions of business energy behavior, much of the residential sector literature describes specific interventions to change residential energy consumption and the relative effectiveness of these interventions.

Katzev and Johnson (1987) provide a significant review of this literature. They classify efforts to promote energy conservation into three main strategies:

1. antecedent intervention, in which information is provided to the target consumer to convince the consumer of the value of taking a conservation action;
2. consequence information, in which information is provided to the target consumer about the effect of actions the consumer has taken; and
3. social influence techniques, which use interaction between the consumer and a larger group to provide “peer pressure” of one form or another to encourage or support the consumer’s conservation action.

After examining each of these strategies, Katzev and Johnson (1987) conclude:

In short, currently the overall consensus of most investigators is that incentive and feedback contingencies have been the most effective techniques in promoting energy conservation. On the other hand, prompts and information techniques have been criticized as relatively ineffective, while social influence techniques have only recently been the subject of experimental analysis. In contrast to these conclusions, we believe that a detailed look at the evidence indicates that consequence techniques are not nearly as effective as claimed and that antecedent strategies may have potential value. Further, we believe that social influence techniques, especially commitment procedures, hold considerable promise for promoting both short-and-long-term reductions in energy use. [Katzev and Johnson 1987, 172]

This is not a resounding encouragement for any one form of behavioral intervention. However, what if one were to combine these forms? It is interesting to note that the utility bill received by both residential and commercial customers can provide several of these forms of information at once. It can provide antecedent information to develop conservation values and intent to conserve. It can provide consequential information about the effect of conservation actions the consumer has taken on typical consumption. It can also provide comparative information about the consumer's energy consumption relative to a peer group. Given this significant opportunity, what is known about the use of utility bills in changing consumption behavior?

2.4 Residential Sector Consumption Behavior – Applicability to the Commercial Sector

In some respects, the small business owner may be hypothesized to behave in a similar manner to the residential customer. One area of overlap is the receipt and payment of the utility bill. The relationship between energy consumption behavior and the receipt of the bill is strong in the small commercial sector, unlike in the large commercial sector. Specifically, the small business owner who uses the energy also pays the bill, or at least has knowledge of the bill. It might be hypothesized that the business owner would be as motivated to reduce energy cost as a residential consumer would be. In fact, the business owner might be even more economically motivated, as business people are more likely to have a "bottom line" focus. Given these hypotheses, what can we infer from the research that has been done in the residential sector?

While the household has been the primary area of analysis in human behavior research, residential behavioral studies provide information that is likely applicable to the commercial sector. Studies of how homeowners understand their utility bills—e.g., Kempton and Montgomery (1982), Kempton and Layne (1994)—found that residential customers’ analytical capabilities were constrained by the form and content of the utility bill. For example, Kempton and Layne (1994) argue that “price and consumption data [are] difficult to acquire and expensive to analyze. ... [B]ills in kilowatt hours meet the seller’s need for revenue flow but ... poorly serve buyer decisions about consumption and efficiency investments.” Kempton and Montgomery (1982) found that families used dollars as the measure of energy consumption because “Dollar measurements, though inexact, offer advantages in household management. Dollars apply broadly to housing, food, and other expenses; thus, they allow comparisons across expenditure categories.” My argument is that there are no obvious reasons why similar issues would not also arise in the commercial sector. Certainly businesses receive much the same information as residential customers do on their bills, and, since small businesses are often owner-managed, they are likely just as interested as individuals in comparing their expenditures across consumption categories.

There has been one main study of commercial energy consumption behavior – a research project involving forty business managers and owners in a New Jersey strip mall. Four papers resulted from this study: Haberl and Komor (1989), Haberl and Komor (1990), Komor and Kempton (1991), and Komor and Katzev (1988). Komor and Katzev (1988) found that, similar to the Kempton and Layne (1994) research, business owners had difficulty identifying components of their

energy cost. The businesses were not able to identify significant components of their bill, such as a demand charge. Komor and Katzev (1988) identified five main themes influencing energy consumption behavior:

1. poor information,
2. no perceived control,
3. the belief that conservation entails reduced comfort,
4. a diffusion of responsibility, and
5. the fact that energy costs are a small percent of gross income.

Of these themes identified by Komor and Katzev, only the fifth does not bridge both residential and commercial actors. Compare, for example, the diffusion of responsibility for the energy bill within a small commercial building with the family management necessary to reduce residential consumption. In both cases, there are a number of energy-using actors in the environment, and effecting change among all the actors can be challenging. Even the fifth issue identified by Komor and Katzev (1988) finds resonance in the Kempton and Montgomery (1982) research: while the families are not concerned with percentages of gross income, Kempton and Montgomery (1982) do mention, "...the small potential savings mean that even diligent lighting managers are unlikely to notice any change in monthly bills, and may conclude that energy conservation efforts are futile" (Kempton and Montgomery 1982, 821).

2.5 Utility Bills and Billing Feedback

Given some of these similarities between residential and small business energy consumers, what policy interventions might be useful in the small business arena?

A number of residential studies have shown that the provision of consumption information can result in reduced energy use. Harrigan et al. (1995) discuss two forms of feedback: feedback based on reading standard utility meters, and feedback based on customer-readable meters. I focus here on the feedback using standard utility meters, as my research interest is in current consumption practices within small businesses. Harrigan et al. find five types of feedback possibilities based on standard metering technology:

1. enhancements to monthly utility bills,
2. more frequent billing,
3. periodic report and analysis,
4. disaggregated reporting of end-use consumption, and
5. consumer reading of the meter.

In a sense, more-frequent billing and self-reading of the meter are two sides of the same coin – an attempt to reduce the time lag between taking actions that result in energy consumption and receiving information about the impact of those actions. More-frequent billing provides the benefit of translating the utility tariff into the specific dollar cost associated with the energy consumption, but there is a practical limit to the number of bills a utility could send out. Self-

reading can reduce the time lag between action and feedback, but (a) it does not provide cost information, and (b) it can become burdensome to the consumer. For example, in one study Winett et al. (1979) found that only half of the study participants performed the daily meter reads they had agreed to perform as part of the study.

The other three types of feedback reviewed by Harrigan et al. are mechanisms to improve the type of information provided to the consumer by the utility. Disaggregated reporting of end-use consumption can help the consumer identify which end uses are the major energy consumers. This can be valuable, as consumers often have inaccurate concepts about the energy consumption impact of specific end uses. For example, while lighting is not a major energy end use in homes, Kempton and Montgomery (1982) found that residential customers overemphasized lighting energy consumption as a percentage of total residential consumption.

The drawback to this disaggregated reporting of end-use consumption as a form of feedback, though, is that it is an expensive mechanism for providing consumption information. The information necessary to estimate end-use consumption is collected through multi-page customer surveys. The surveys are time-consuming for the customer and expensive for the utility to analyze. Harrigan et al. (1995) conclude, "...while it probably is valuable for a one-time identification of which end-uses are the larger ones—an important function—it would not be desirable to mail repeatedly for ongoing feedback to evaluate customer-initiated changes" (Harrigan et al. 1995, 25).

The final two forms of consumption feedback – enhancements to utility bills and periodic reports and analysis – can work well together. As Harrigan et al. write, “A periodic report assumes bills already are sent monthly and provides a separate mailing with longer-term, or more extensive, analysis of energy consumption” (Harrigan et al. 1995, 24). Periodic reports can go into greater detail or provide information in a format (e.g., large graphics) that cannot be fit onto the constrained space of a monthly utility bill.

So what can fit on a utility bill? What types of information can be useful on a monthly basis? Two significant feedback mechanisms are historical feedback, in which consumers receive information about their prior energy use; and comparative feedback, in which consumers receive information about their energy use compared to others.

Siero et al. (1996) conducted a study of energy consumption feedback within two geographically separate units of a metallurgy company. Both units received information about how to reduce energy use, and both received information about their unit’s energy consumption relative to a defined baseline every week for twenty weeks. I term this “historic feedback” – each unit received information about its energy consumption history. In addition to the historic feedback, one of the two units also received information about the other unit’s consumption. I term this “comparative feedback.” Energy consumption decreased within both units, but the unit that received comparative consumption feedback showed a greater energy consumption decrease. In addition, energy consumption within both units remained reduced six months after the information campaign had concluded. The unit which received comparative feedback still maintained

a lower energy consumption level than the unit which received only historic feedback. In other words, consumption feedback was shown to have a significant and lasting effect, and comparative consumption feedback was more effective than just historic feedback.

2.6 Hypotheses and Proposed Model of the Commercial Energy Consumer

Based on my review of the literature, I find a dearth of direct data on small business energy consumption behavior. Those field studies that have been done suggest that the behavior of firms is more complex than the market barriers discussion suggests. Public policies that are based on the market barriers analysis are likely to be overly simplistic and ineffective as a result. My research topic aims to illuminate this gap in the understanding of commercial sector energy consumption behavior by interviewing business decision-makers, examining the understanding they receive of their energy consumption through utility bills and their interest in receiving enhanced consumption information. By developing an understanding of business decision-makers through direct interaction with them, rather than inferring it from macro-level analysis, my research will have the ability to inform public policy development that recognizes this complex behavior and can be more effective.

In developing my model of the commercial energy consumer, I have been strongly influenced by Kempton and Montgomery (1982) and Kempton and Layne (1994). Kempton and Montgomery begin their study by noting, “Consumers measure energy using techniques that differ from those of professional energy analysts.” I believe that to be true of commercial-sector

consumers, too. As I mentioned earlier, I see no obvious reasons that the residential-sector findings of Kempton and Montgomery (1982) and Kempton and Layne (1994) would not apply equally well to a person operating in a business environment.

Kempton and Layne (1994) discuss the “energy analysis environment” – the context within which an energy consumer makes decisions about energy use. This type of analysis addresses the weaknesses of many of the commercial-sector studies referenced above – it examines the business owner in rich detail and allows the owner to provide information about how he or she makes decisions rather than inferring the decision process from aggregate data.

Because so little of this kind of analysis has taken place in the commercial sector, I went into my research seeking to develop a model of the commercial energy consumer, much as Kempton and Layne (1994) did for the residential sector in their research. The most obvious source of information available to the commercial consumer about their energy use is the utility bill. My working hypothesis was that commercial consumers would use their energy bills in a manner similar to that described by Kempton and Layne (1994). To confirm this, I developed an interview protocol that asked about how utility bills were processed by my informants. Komor and Katzev (1988) identified five themes that influenced behavior in small businesses, as mentioned above. I assumed that I would find the same themes. My open-ended interview questions were meant to elicit similar information to confirm these themes. Finally, as Siero et al. (1996) and Komor and Kempton (1991) suggest from their findings, comparative feedback may be useful to some commercial consumers and encourage energy

consumption reduction. My work with the Energy Star Billing program at the University of Delaware suggested that the group to which the informant was being compared could have an impact in the validity the informant placed in comparative feedback. I believed commercial consumers would see businesses like theirs similar to residential customers households like theirs. Building size, location, and economic activity would be the general mechanism for developing business peer groups for comparison. For example, I believed that the owner of a small business located in a shopping mall would see a comparison of her business to any other store of roughly the same size in the mall as valid. Similarly, I believed that owners of franchise businesses would accept comparison with other owners of the same franchise.

With these general outlines in mind, I set out to understand more fully the commercial consumer's decision-making context.

Chapter 3

METHODS

The following section discusses the methods used to gather and analyze my data. I lay out the reasoning behind my choice of semi-structured interviewing, describe the research questions that guided my data collection and their conversion to interview questions, and explain how I selected the people I interviewed.

3.1 Need to Understand Business Environment

As discussed above, there has not been a great deal of attention paid in the energy policy literature to the reasons that small business consumers make the energy choices they do. Those theoretical frameworks that do exist to explain commercial sector energy consumption behavior are based largely on a priori hypothesis and macro-level analysis. There is, therefore, no substantial theoretical literature informed by empirical data on why businesses behave the way they do with regard to energy consumption.

As a result, I believe quantitative data gathering methods are inappropriate for developing an in-depth and detailed understanding of business behavior. Structured data collection techniques; e.g., surveys, have a high potential for misinterpretation of meaning by both informants and researchers. For example,

a seemingly straightforward survey question might be, “Does your utility rate include a demand charge?” However, as the New Jersey strip mall studies above showed and my research confirmed, many companies who were being charged for demand did not realize that it was a component of their cost. As a result, they would likely have incorrectly answered “no” to such a survey question, even if the term “demand” were carefully defined by the survey. Quantitative analysis of statistical response to survey questions, therefore, would likely be strongly biased by the survey design. Absent a good theoretical framework describing business decision-making, creating a survey with wording interpreted identically by both the surveyor and the person surveyed would be difficult to validate.

3.2 Use of Qualitative Techniques

My doctoral research focused on developing an understanding of the context within which businesses made their decisions. To develop this contextual understanding, I used semi-structured interviews with business owners across the United States.

Semi-structured interviewing is a data collection process that allows for interplay between the interviewer and informant. By providing for the opportunity of capturing information not anticipated by the interviewer, it helps avoid the issue of over-specifying the data collected. At the same time, the use of an interview guide helps keep the interview focused, making sure that specific issues get covered. As Bernard (1994) puts it:

In situations where you won't get more than one chance to interview someone, semi-structured interviewing is best. ... The interviewer still maintains discretion to follow leads, but the interview guide is a set of clear instructions... [Bernard 1994, 209-10].

I felt it necessary to conduct the interviews in person. While interacting with the informant, I could examine the utility bill with the informant and carefully identify the specific bill components that were or were not used in the informant's comprehension and analysis of the bill. I also felt it important that I not impose too much of a structure on the allowable responses, as so little is known about the environment in which these decisions are taking place. Using in-person semi-structured interviews, I was able to deal with the situation of the demand charge described above, for example, by

1. identifying the demand charge as present on the bill (since I was looking over the bill with the informant),
2. explaining the concept of a demand charge when it was not understood, and
3. recording the reaction to that piece of information, including the informant's thoughts about potential change in energy consumption as a result.

3.3 Research Questions

My intent was to gather primary data about how business decision-makers use the utility bill as a mechanism to relate their energy consumption to cost. Furthermore, I wanted to try to understand why they come to the conclusions they do. How is the bill information received by decision-makers within the

company? What is the thought process that takes place when reading the bill? What information is used, and what information is discarded? Is additional information desired? Etc.

I went into the field with three research questions:

1. How do business decision-makers understand the utility bill?
2. How do business decision-makers respond to the information from the bill?
3. Would certain types of comparative information cause business decision-makers to respond differently?

In testing the interview protocol, I realized that a fourth research question was necessary: how is the utility bill processed within the organization? There were a number of differences in the ways businesses received the information, from a small business owner who received the utility bill herself, to a business owner who sent all bills to an accountant and only saw accountant reports, to a firm that processed the utility bill through the accounts payable department.

To answer these research questions, I created a semi-structured interview guide leading the interview through these issues. The guide can be found in Appendix A.

3.4 Sampling

The context in which energy consumption decisions are made within the business sector varies widely. For example, there are a wide variety of business

types in the United States. The United States Department of Energy's Energy Information Administration defines 13 subgroups of commercial sector building activities, and those do not take into account agricultural or industrial activities. There are a variety of types of business ownership: private or public ownership, single or multiple owners, one store or many, franchise affiliation or unique, etc. There are wide variations in the amount of energy businesses consume. There are innumerable variations in the energy tariffs businesses pay.

Given this universe of potentially intertwined variables, conducting any sort of representative sampling was well beyond my capabilities. It is possible that, given enough time and data, one might be able to conduct a factor analysis that broke down business energy consumption characteristics into a relatively small number of predictive variables. Unfortunately, that research does not seem to have been done, and I did not have the funding to undertake such a massive project. Therefore, I chose to use nonprobability sampling.

One criticism of the New Jersey strip mall set of studies was that it was specific to one location and one set of actors (stores in a retail mall.) Therefore, I defined three key criteria at the beginning of my research: geographic location, business type, and size. In addition, I wanted to get a range of informants within each of these categories. I identified potential interview informants via a number of mechanisms, including social acquaintance, participation in the Energy Star/Green Lights program, and simple "cold calling."

As an example of the latter, I spent several hours visiting commercial districts in two cities, one on the West Coast and one on the East Coast. In each, I walked

into stores and asked if I could speak to the owner or manager. I would then tell that person that I was doing research on energy consumption in the business sector and ask if I could talk with him or her about the utility bill the business received. When I would visit a new city, I would stop in at a business or two at random and do the same. It was surprising how often this was effective. I found that people were much more willing to spend time speaking with me than I had feared at the beginning of the project.

While the selection of informants was basically opportunistic, I tried to keep in mind my general criteria of location, type, and size of business. The larger businesses required some preliminary data gathering to identify the particular person identified as responsible for the utility bill. In these cases, I usually had prior information from social acquaintance or the business's participation in EPA's Green Lights program to guide me to the proper individual; however, one or two of the large informants also ended up being picked completely opportunistically. As a part of this sampling process, some large manufacturing firms (i.e., industrial sector consumers) were included in my interviews; however, the primary source of data was commercial sector consumers.

Each interview informant confirmed that they were either the person who received the utility bill or the person within the organization who made decisions about energy use.

Forty-four (44) business informants were interviewed. These businesses were spread across 20 cities in 10 states. The businesses included a wide variety of business activities. Business sizes ranged from one employee to over one

thousand, with revenue ranging from thousands of dollars to millions of dollars annually. Monthly utility bills ranged from less than one hundred dollars to several hundred thousand dollars, with a wide variety of tariff structures and energy providers.

The following tables show some of the characteristics of my informants, by geographic location (Table 3.1) and by type of business (Table 3.2). Size of business is discussed in Chapter 4, as my categorization of business size was affected by the interview process and analysis of the responses.

Table 3.1

Distribution of informants by location

Location	Number of Informants	Percentage of Total Informants
California	14	32%
District of Columbia	3	7%
Illinois	2	5%
Massachusetts	2	5%
Maryland	2	5%
New Jersey	1	2%
New York	1	2%
Ohio	4	9%
Virginia	8	18%
Vermont	7	16%
Total	44	100% [†]

[†] Individual percentages do not sum to total due to rounding

Table 3.2

Categorization of 44 informants into 34 types of business

Type of Business		
Auto Repair (2)	Auto Sales	Barbershop
Bike Shop	Church	College (2)
Day-care Center	Dentist	Dry Cleaner
Fast Food Franchise	Fitness Center	Furniture Store
Gift Shop	Grocery Store (2)	Hardware Store
Health Food Store (2)	Hospital	Hotel
Ice Cream Store	Insurance Company	Lawyer
Liquor Store	Mail Order Bakery	Manufacturer (5)
Martial Arts School	Mortgage Banker	Municipality
Printer (2)	Private school (2)	Psychologist
Restaurant	Retirement Community	Shoe Repair
	Wood Stove Store	

3.5 Interview Conditions

Interviews were conducted from December 1997 through February 1999.

The interview data were captured either by audio tape and transcription (29 interviews) or interviewer notes, based on informant preference, ambient noise, and other factors.

3.6 Data Analysis

The residential sector research by Kempton and Montgomery (1982) and Kempton and Layne (1994) established a number of characteristics of the decision-making context of energy consumers in the residential sector. The New Jersey Mall studies, particularly the work of Komor and Katzev (1988) extended knowledge of the decision context to (one component of) the commercial sector.

To analyze the data I collected through my interviews, I based some of my initial questions on these previous studies. How did the responses I received compare and contrast with these earlier studies? As I have discussed in the Background section, I believe these studies left much unconsidered in the behavior of small businesses. Jumping off from the foundation the studies provided, I used my own interpretations of patterns in the data.

The next chapters will discuss the interview results and their relation to each of the research questions I mentioned above. In chapter 4, I discuss the way business decision-makers processed the bill itself. In this analysis, I look at several issues:

1. Information availability. How was the utility bill handled once it was delivered in the mail? Who received the information?
2. Information comprehension. How did the decision-maker understand the bill? Which components of the bill were useful? Were any of them misunderstood?
3. Attitudes about consumption. How did the decision-maker make choices about energy use? What informed those decisions?

In chapter 5, I discuss consumption self-comparison — the decision-maker's comparison of current energy use with historic energy use. In doing so, I analyze:

1. What information is available to the decision-maker? Do they keep bills? How long do they keep them?
2. What kinds of comparisons do decision-makers use? What units do they use to make the comparison?
3. What do they do if their energy consumption seems unusual?
4. What kinds of self-comparison information would the decision-maker like to see?

In chapter 6 I discuss comparative consumption — the decision-maker's comparison of current energy use to the energy use of other businesses. In this analysis, I examine:

1. Are decision-makers making consumption comparisons already? If so, how?
2. What groups do decision-makers view as appropriate groups with whom they should be compared?
3. What would the decision-maker do if a comparison revealed that their energy consumption was unusual?
4. What kinds of comparative consumption information, if any, would the decision-maker want to receive?

Finally, in chapter 7 I discuss information sources available to business decision-makers:

1. To whom would the decision-maker turn to receive information about energy consumption alternatives?

2. Is the Internet a useful source of information?
3. How do decision-makers perceive the Environmental Protection Agency, and particularly the Energy Star program, as a source of energy consumption information?

In answering these questions in each of the analysis chapters, I relate the responses to earlier studies when applicable and develop new models when required.

Chapter 4

ANALYSIS: ANTECEDENT INFORMATION

In this chapter, I discuss the decision-making context within which my informants made choices about their energy consumption. I first differentiate my informants into several categories, primarily by size of business. I then discuss the process by which they received utility bill information. I conclude this chapter with a discussion of my informants' comprehension and utilization of the information they gleaned from the bill.

4.1 Business Size

As indicated in the Background and Methods sections, one potential criticism of the research done in the New Jersey Mall studies was that it had been done at only one location with firms of generally the same size. I purposely sampled firms of multiple sizes to examine whether or not size would affect the energy consumption decision-making environment.

It became clear through my interviews that businesses did vary substantially by size of business in their decision-making contexts with regard to energy consumption. On the one hand, this might be regarded as an obvious finding - surely multi-national conglomerates make choices about all types of business issues in ways different than small "mom and pop shops" do. At the same time,

this characteristic is largely unmentioned in the energy policy literature. As a result, the energy policy literature has been incomplete and misleading because it has left this important factor largely unanalyzed.

One thing that might explain this omission is that it was often difficult to discern exactly what made one business different from another in their decision-making contexts and processes. There was no single characteristic of the firm that easily explained why it fit into a particular category, although there did seem to be clear categories into which businesses fell. Ultimately, a variety of firm characteristics determined the category into which I placed a particular firm's responses. Working inductively from my sense of the difference among these firms, I established a categorization to distinguish among firms that were most different. In this manner, I divided my informants into four categories: small businesses, medium-sized businesses, large businesses, and a fourth hybrid – franchise businesses. I use these size names to distinguish among the categories of businesses, although the categorization is based on several criteria, as discussed below.

4.1.1 Small Businesses

Small businesses ranged from one employee to twenty or more, but one employee (usually the owner) made decisions about both energy consumption issues and other business decisions. These businesses were quite frequently on a consumption-only electricity tariff, and their monthly bills typically did not exceed several hundred dollars. The energy decision-maker received and paid the utility bill. The business was operated out of a single location.

4.1.2 Medium-sized Businesses

Medium-sized businesses had more employees than small businesses, from ten to fifty or more. In these businesses, utility bills were correspondingly larger, in the several hundred dollars to thousands of dollars per month range. At this size, there was typically someone other than the primary business decision-maker who was tasked with managing energy consumption in the company, although that did not necessarily mean that the person tasked with energy issues had any experience or training with facilities management, energy engineering, or other technical skills. While utility bills were often handled by an administrative employee tasked with financial issues, the primary decision maker often completed payment of the utility bill (see “Mail Processing” below). Electricity tariffs for these firms often included demand charges and more complex consumption charges; e.g., time of use rates. In contrast to the large firms described below, these firms usually operated out of one location, though they sometimes had multiple buildings.

4.1.3 Large Businesses

Large businesses ranged from fifty employees up to thousands of employees. In these businesses, utility bills were at least thousands of dollars per month and could be much higher. Electricity tariffs for these firms almost always involved demand charges. Often, the firms received electricity service at higher voltages than that provided to the smaller firms, with correspondingly different tariffs. One or more employees was tasked with energy management issues, typically as a function of facilities management. These employees

had training and/or experience in engineering, were familiar with the technical details of the business's energy-consuming technologies, and usually had their own budget for operations and maintenance. Utility bills in these firms were typically processed by an accounting or other administrative department that had authority to pay the bills without involvement of the employee tasked with management issues (see "Mail Processing" below). Often these firms had multiple buildings and/or multiple locations of business operations.

4.1.4 Hybrid

While many informants could easily be categorized into one of the three business size categories above, there were a few that stood out as unusual because they combined features of two categories. The most common example of this was informants who owned multiple businesses; e.g., a dry cleaners owner with two stores, or a franchise fast food owner with multiple locations in town. Each location had characteristics of the small business category, but some of the bill handling features of the firm would be more like medium-size businesses. Decisions about energy investment were typically made by the primary business owner, but they were affected by the receipt of multiple utility bills.

Table 4.1 summarizes the characteristics of these categories.

Table 4.1

Characteristics of Firms by Size

Firm Size	Number of Employees	Number of Locations	Type of Electricity Tariff	Monthly Utility Bill Amount	Bill Processing	Facility Manager?
Small	Less than twenty employees	One location	Consumption-only	Not exceeding several hundred dollars	Decision-maker receives and pays bill	No
Medium	Ten to fifty employees	Typically one location, though multiple buildings	Often more complex than consumption-only	Hundreds to thousands of dollars	Bill processed by administrative staff, though handled by primary decision-maker	Often "energy manager" other than owner, but not technically trained
Large	Fifty to thousands of employees	Multiple buildings, multiple locations	Complex tariffs	Thousands to hundreds of thousands of dollars	Bills processed by separate administrative department	Yes, typically technically trained
Hybrid	Usually one to fifty employees	Often multiple locations	Varies	Usually not exceeding thousands of dollars	Business owner makes energy decisions	Perhaps, but usually not technically trained

Table 4.2 provides the distribution of my 44 informants into these four categories.

Table 4.2

Distribution of Informants by Firm Size

Firm Size	Number of Informants
Small	23
Medium	7
Large	11
Hybrid	3

With these four categories in mind, I now turn to discussion of how informants received their utility bills, processed the information on those bills, and expressed the importance of energy consumption (and changing energy consumption) in overall business operations.

4.2 Mail Processing

There were typically two sets of information that a commercial customer received from the utility company: the utility bill itself, and “bill stuffers” – additional information from the utility about the utility’s activities. These bill stuffers often included information that might help a business change its energy consumption. There were significant differences in the way informants handled these two sets of information.

4.2.1 Bill Stuffers

Bill stuffers are essentially mass mailings, and mass mailings are known for low response rates. As a result, it is not surprising that bill stuffers are often ignored by their recipients. Our interviews revealed that this problem is often exacerbated in the business sector by the problem of inter-organizational mail processing.

In the small business case, the recipient of the mail containing the utility bill was often the business owner. In this case, the potential for the bill stuffer to be read by the decision-maker still existed; however, informants regularly reported throwing away everything in the utility mailing but the bill itself. Here, for example, is what the owner of a small law firm had to say:

(INFORMANT): I do get [the utility bill] in the mail.

(INTERVIEWER): Where does it go from there?

(INFORMANT): The secretary opens it and gives it to me.

(INTERVIEWER): And she gives you the whole thing?

(INFORMANT): Yes, everything is attached. I don't read anything of it; I throw everything away, but the bills and the envelope.

(INTERVIEWER): Do you glance over it or something?

(INFORMANT): I don't even glance over, just throw it away. And then we pay the bill and [it is] one of those necessary evils.

The behavior of just throwing away everything but the bill itself was reported quite regularly. In this case, the owner received the mail from the secretary. In larger firms, the separation between initial mail processing and the decision maker became greater. The mail would often be handled by an administrative person who would discard everything but the bill itself before passing it on to the decision maker. Bill stuffers are therefore very unlikely to ever reach the target audience. This phenomenon is in substantial agreement with the findings of Komor and Katzev (Komor and Katzev 1988, 236).

4.2.2 Metered Consumption/Cost Information

While bill stuffers were summarily discarded, the bill itself was always processed within the firm. As the response of the lawyer above demonstrated, in the small business case, the decision maker usually at least looks at some of the information on the bill. Even this is not always the case, as the case of this mortgage banker showed:

(INTERVIEWER): So, how do you get your bill?

(INFORMANT): We get it in the mail. I don't open it. I send it directly to my person who pays my bills. She opens it, and looks at the bottom line, and pays it. And we never think about it again.

(INTERVIEWER): You don't even see it at all? You never even open the envelope?

(INFORMANT): No, I don't like to look at what I have to pay out every month. It makes me queasy.

While this was an unusual response, it illustrates how difficult it can be for consumption information to get to the decision maker. It seems particularly ironic that the owner of a business dedicated to financial analysis would completely ignore his own business expense.

As firms got larger, the bill would be handled by multiple actors within the firm. I would have expected that a division of labor would begin to occur, and that the business owner would become more isolated from the bill. As it turned out, the medium-size informants often maintained some level of direct interaction with the bill, as this private school owner's response illustrates:

(INTERVIEWER): Are you the person that would make decisions about energy use here in the office?

(INFORMANT): Well, I'm the owner of the school; however, I have my bookkeeper who kind of keeps track of all. She is the one that pays the bills and calls when we have problems and so forth.

(INTERVIEWER): So do you receive the bill, or does it go directly to the bookkeeper?

(INFORMANT): I receive all the bills and then it goes directly to her.

(INTERVIEWER): Do you open it?

(INFORMANT): I open, well, my secretary opens it and puts it on my table, and then I look at it....

The energy manager at a church reported something quite similar:

(INTERVIEWER): So, tell me about your utility bill. What happens when it comes in?

(INFORMANT): I look at it. The process normally is that they will put the utility bill in my box, so that I will look at it.

(INTERVIEWER): Unopened?

(INFORMANT): Unopened. Usually unopened. They know what they are, they will give them to me. What I will do, I will go through them and kind of do a quick review to see, kind of get a feeling if that all we are in the ball park that I think we are supposed to be in, from a budgetary standpoint, or do we look like using more, or we are using less. And of course if we are using less I am happy, if we are using more I have to go back and kind of say, have we had a counter events that precipitated this additional use, or if not what, then what is the problem, and try to figure that out. Then once I have looked at it and I have approved it and I pass it on to ... our bookkeeper, and then she keeps all of the records. And she keeps them for years and years. And so whenever I have a question about what did we do last year this time, she can, she tells me that.

(Discussion of the issue of bill filing and anticipation of cost takes place in Chapter 5.)

As firms got larger still, though, a clear disconnect did exist between the recipient of the utility bill and the energy decision maker. Bills typically went to an accounts payable or similar department. However, informants in these firms had devised ways around this.

For example, copies of the bill were often circulated among multiple personnel within the company. One company brought together an “energy council” of staff from a number of different departments, including facilities, security, energy management, and finance. In several cases, the energy managers at the firm received utility consumption data (i.e., meter read information) directly from the utility, often in electronic form. One pharmaceuticals firm had devised a sophisticated internal system that provided daily information about electricity consumption:

(INFORMANT): [W]hat we have done is, we have actually set up a ... program that will write that for us. It starts to identify load drivers. We have like 38, something like that, electric meters on this site, so we can identify: what is our air conditioning load? What is our process load? What is our computer room load? We can identify all those and kind of totalize, so that someone can look at that, and can say this is what our computer room's costing us, or this is what our laboratories are costing us.

Overall, therefore, staffers seem to reach an exceedingly small percentage of the market; however, information included on the bill itself does reach a larger fraction of business decision-makers than might be anticipated, and all

decision-makers with whom we spoke were at least aware of the dollar amount owed to the utility.

4.3 Bill Components

Turning more specifically to the metered consumption and cost information; i.e., the utility bill itself, there were a number of issues that various components of the bill brought out. As I interviewed the informants, I would ask them to show me a copy of a recent utility bill, and we would look over the bill together. The following section describes responses to several of these specific components.

4.3.1 Consumption vs. Demand

One striking finding of the New Jersey Mall study was the lack of familiarity the informants had with the demand charges they received on their bills. I went into my research prepared to find the same problem. However, small customers were often on consumption-only tariffs, similar to residential customers.

Medium-sized customers were sometimes on a consumption-only tariff, but they were usually big enough to receive demand charges. These customers often had problems recognizing the demand charge. Even if the demand charge could be described, informants often felt unable to control it in any way. Even those who did take action to reduce their demand charge often took consumption reduction actions rather than demand reduction actions. For example, they might try to turn lights off or lower their thermostat settings rather than stagger equipment start times.

Large customers with separate facilities departments understood demand charges and generally recognized their importance as a component of their total energy cost. Even with very well-trained staff, though, some misinterpretation of tariffs was not uncommon. One demand-ratchet tariff completely baffled the facilities department of a federal office building. While the demand charge ratchet was creating a significant ongoing charge for the office building, the per-kilowatt-hour consumption portion of the tariff was quite low. The staff focused on the low per-kilowatt-hour charge and, based on that focus, eliminated potential energy control measures as not cost-effective. Once the ratchet component of the tariff was fully understood, the building was able to reduce their energy cost by tens of thousands of dollars simply by shifting the hours the building's chillers were operated in the summer.

4.3.2 Page Layout

A problem that occurred multiple times when informants described their process of interpreting the bill had to do with the presentation of data on the bill. Prior research has shown that seemingly obvious information cues on the bill could be misinterpreted, so this was not unexpected. For example, Egan et al. (1996) found that graphics thought to be self-evident to researchers were interpreted incorrectly by informants. In several instances during my research, the layout of the meter data on the utility bill affected the informant's interpretation of the data and led to faulty conclusions.

In the first instance, a bill with a standard consumption-only tariff, the previous month's meter reading was shown first, then the current month's reading was

shown to the right, and finally the total usage for the month was shown to the right again. An example of this is shown in Figure 4.1.

Service:	From 10/10/97 To 11/12/97	Billing Days: 33	Electric Meter #: [REDACTED]		
Electric	<u>Prior Meter Read</u> 29508	<u>Current Meter Read</u> 31200	<u>Difference</u> 1692	<u>Constant</u> 1	<u>Usage</u> 1692 Kwh

Figure 4.1

Example of confusing consumption-only bill format (Pacific Gas & Electric, California)*

* This figure (and other figures to follow) is a direct reproduction of the informant's actual utility bill. Unfortunately, the source documents from which these figures were drawn were themselves photocopies or faxes of the utility bill itself, provided by the informant during or immediately after the interview. I believe there is value in showing components of the actual artifact used during the interview process rather than simply replicating examples; however, the result is figures of mediocre illustration quality.

Several of our interview informants ignored the last column and read the first two columns as last month's and this month's consumption, rather than the meter values. As a result, they believed their energy usage to be consistently increasing over time.

Additional elements on the bill layout contributed to the confusion. In the example above, because the meter constant was one, it had no effect on the kilowatt-hour consumption reported. As a result, it could easily be overlooked or ignored by a decision-maker. Other bills used different meter constants, and these provided an additional level of confusion. Informants were not clear on what the constant was meant to convey.

Furthermore, information extraneous to the calculation was sometimes included in the display. An example of both of these problems is shown in Figure 4.2.

CURRENT READ	DATE	DAYS	CURRENT READING	PREVIOUS READING	CONSTANT	METER NUMBER	USAGE	AMOUNT
DEC 03 98		34	570	9887	720	████████881	491760	7,716.55

Figure 4.2

Example of confusing meter information (Virginia Power, Virginia)

While the meter number and the date of meter reading are both useful pieces of information in isolation, their presence in the information provided as shown above leads to confusion. This example is particularly confusing because the meter apparently rolled over and reset to zero during the month. Even if one has a good grounding in comprehending utility bill information, the calculation necessary to determine consumption and cost from the information above is a complicated calculation to make. One must take the following steps to understand the above:

1. Ignore extraneous information such as the meter read date, the number of days in the billing period, and the meter number.
2. Understand that meters may roll over and reset to zero, as this one apparently did at 10,000.
3. Add 570 to 10,000 to get the effective current reading.
4. Subtract 9887 from 10,570 to get the metered value (683).
5. Multiply the metered value by the meter constant to get kilowatt-hour consumption.
6. Multiply the kilowatt-hour consumption by the per-kilowatt-hour cost (which did not appear on the bill) to get the dollar cost of the consumption.

This is clearly not something that most people will do quickly or easily when they receive a bill. As a result, all of the information becomes extraneous during the bill processing phase and is effectively lost.

In another example, a time-of-use tariff, a similar comprehension problem caused by bill layout occurred. This bill layout is shown in Figure 4.3.

BILLING INFORMATION				
	ITEM #1	ITEM #2	ITEM #3	ITEM #4
METER NUMBER	173	316	316	316
SERVICE	GAS-CSLV	ELEC-LPLS	ELEC-LPLS	ELEC-LPLS
PERIOD	03/31 04/30	03/31 04/30	03/31 04/30	03/31 04/30
METER READING		ON-PEAK	INTERMED	OFF-PEAK
PRESENT	95390	04315	00881	05043
PREVIOUS	93756	04271	00872	04994
DIFFERENCE	1634	44	9	49
MULTIPLIER	1.0120	400.00	400.00	400.00
USE-CCF/KWH	1653.608	17600	3600	19600
THERM MULT	1.03300			
THERMS	1708.177			
THERM/KW DMD		124.00	92.00	96.00
KW DEMAND CR		68.20	50.60	52.80
<hr/>				
SERVICE CHG	\$ 53.57			\$ 368.64
TRANS CHG	139.44			
THERM/KWH CHG	589.85			
ON PEAK KWH		17600 X	\$.093240	1641.02
INTERMED KWH		3600 X	\$.082960	298.66
OFF PEAK KWH		19600 X	\$.066640	1306.14
ON PEAK KW		68.20 X	\$ 7.610000	519.00
INTERMED KW		50.60 X	\$ 1.170000	59.20
OFF PEAK KW		52.80 X	\$ 1.170000	61.78
NET RECOVERY				
\$ 0.0062730	10.72			
ENGY ADJ/KWH				
\$ 0.0102190CR				416.93-
<hr/>				
TOTAL	\$ 793.58			\$ 3837.51

Figure 4.3

Example of confusing time-of-use bill format (Public Service Electric & Gas, New Jersey)

This is clearly a complex bill, but it is made more so by the way the information is presented. Interestingly enough, in this bill format, the meter reading information (rows 4 through 9 on the bill) is presented in a more mathematically standard format. The current consumption (line 5) is presented first, the prior month's consumption (line 6) is presented next, and the difference (line 7) is presented as the difference between the two. Unfortunately, the same left to right problem as the earlier example came up here with the time-of-use time periods. The interview informant, a certified public accountant with an MBA, read the third column (off-peak) as the sum of the first two columns (on-peak and intermediate.) In this case, visual clues could easily lead to that conclusion, as directly underneath the third time-of-use column (labeled "Item #4" on the bill) was the summation of the bill charges.

In all of these cases, it was extremely difficult for the consumer to make an accurate correlation between energy consumption and energy cost.

These data interpretation problems occurred in several interviews. A more common problem, one that was mentioned in almost every interview, was the perceived clutter of the bill. Informants often expressed puzzlement and frustration at the variety of charges, cost adjustments, and taxes listed on the bill. This was exacerbated in locations where utility deregulation was underway and the various components of energy service were listed; e.g., transmission, distribution, generation, etc. Several of these components are discussed below.

4.3.3 Tariff Precision

Tariffs were often reported to six or more decimals; i.e., ten-thousandths of cents, as in the column labeled “Item #3” in Figure 4.3 above. Informants found that degree of precision distracting, which led to a general disregard of the information presented. Some reported suspicion that the utility was trying to hide additional charges in the long strings of cost.

4.3.4 Itemized Billing

The presentation of multiple distinct charges on the bill was a source of confusion and frustration for many informants. Rather than receiving a single charge for energy consumption, informants would receive a bill that included separate line items for various administrative charges, funds, taxes, and credits in addition to the charge for kilowatt-hours consumed. Moreover, the kilowatt-hour consumption charge was often itself not one single charge but a collection of multiple components. Increasing or decreasing block tariffs might create additional charges. Time-of-use or demand charges would create additional lines.

By providing itemized components of the customer’s cost, a utility provides a great deal of detail about the elements of the total cost to the consumer. However, rather than feeling better-informed, informants were often overwhelmed by the information. In many cases, they were unclear as to what the various charges on the bill meant. One can get a sense of the confusing nature of the bill from this statement from a fitness facility’s owner:

(INFORMANT): I don't really know what the different ones [line item charges] are for. This is always the same, whatever the second one is, it is always 5 and these other ones vary. The top and the bottom vary from month to month, not by a lot. This I think that is how much the totals were. This is the total units we are using, but that in the month that we use more energy, that number is higher, this first demand number is higher.

Another example of bill itemization was a line item reporting the distinction between summer and winter rates. One informant, an ice-cream store owner, indicated that this text reporting the seasonal energy cost adjustment reflected the semi-annual rate increase that the utility imposed. In other words, this informant believed that the utility raised electricity prices every six months.

4.3.5 Meter vs. Business

There would sometimes be multiple meters serving a business. This most often began to happen at the mid-size business level. Multiple meters sometimes led to confusion, as this private school owner's response illustrates:

(INFORMANT): Well, I mean I look up at the address and tell which one goes up there, but for some reason or other we get more than one bill for this building and I've never been quite clear why that is.

Another informant received bills for three different locations, and the three locations were on three separate rates. The informant had not realized the difference, nor could he explain why there would be a difference.

4.3.6 Tariff Comprehension Summary

The results of this research identified a significant lack of understanding of the charges on the utility bill. In general agreement with Komor and Katzev, we found that the demand charge was often a misunderstood component of the bill, though the prevalence of a demand charge was smaller than had been anticipated, particularly with small business customers. Small businesses were often on consumption-only tariffs, but expressed unfamiliarity and resignation at the way the total bill was calculated. As the businesses got larger and tariffs became more complicated, a lack of understanding of the method of calculating the various components of the charge became prevalent. Time of use rates were understood somewhat, in that informants knew they were being charged different amounts at different times of the day; however, very few could identify the blocks of time. Demand charges were almost entirely misunderstood. Very few informants in the medium-sized business category could even identify the demand charge as a component of the bill, much less explain the concept or identify ways to lower the charge.

Among large firms, misinterpretation of the bill's components was not as prevalent. These firms generally had specialized energy managers, and they were quite familiar with the bill components and terms when asked about them. At the same time, the example of the particularly-complex tariff at the federal building shows that the interpretation the energy managers have about the tariffs is not always correct. In sum, some misinterpretation of the utility bill, its components, and the tariffs underlying the bill was found in every category of business.

4.3.7 Relative Consumption of End Use

We found that a number of companies faced the same problem as residential customers with regard to understanding the end-use breakdown of energy consumption, as previous studies have shown; cf. (Kempton et al. 1985; Komor and Katzev 1988). However, we did not find the same level of perceptual salience response these other studies had identified. Komor and Katzev wrote,

When asked which appliances used a lot of energy, many informants mentioned appliances that were noisy or easily controlled.... Less visible or controllable appliances, such as refrigerators or air conditioners, were often ignored. (Komor and Katzev 1988, 236).

Lighting, for example, was mentioned very rarely as a major consumer of energy by our informants, although it is easily controlled and quite visible. HVAC system performance was most often mentioned as the reason for high energy bills.

At the same time, though, one reason for the dismissal of lighting as a major consumer of energy might be that most informants had businesses that used fluorescent lighting. Fluorescent lighting was typically seen as an inherently efficient light source. For example, the owner of a furniture store said:

(INFORMANT): ...And the lights, we've examined the idea of the lights as far as changing those. You're not going to get much cheaper than fluorescents....

The lights in question were eight-foot F40 lamps in bare fixtures—quite poor from a energy-efficient lighting system standpoint. Because the informant

believed fluorescent lighting to be efficient lighting, though, the perception was that nothing could be done to reduce the energy cost associated with the lights.

While the issue of end-use breakdown affected both small and large firms, we found a significant difference in the use of the energy bill to determine end-use consumption. Decision makers in smaller firms largely used their intuition to identify energy consumption devices, and did so on the basis of monthly consumption alone. Larger firms, on the other hand, were more attuned to demand fluctuations and were therefore interested in daily or even hourly data. Because they could not receive this information from the monthly utility bill, they had devised strategies to calculate energy consumption within the business on this finer degree of detail, as the example of the pharmaceutical company illustrated. Informants also reported using standard techniques of energy management systems or buying utility data. Beyond those typical techniques, large business informants also reported techniques such as having the security or janitorial staff read the meters every night as part of their rounds, or installing their own meters at a more end-use specific level than the utility provided.

4.4 Attitudes About Consumption

After discussing components of the bill with the informants, the interview moved on to a general discussion of attitudes toward the utility bill and energy consumption in general as a function of their business operations. The final set of questions had to do with general impressions of the importance of reducing energy cost to the business. Three factors were significant within this area:

1. the intangibility of energy consumption as an identifiable, ongoing business cost;
2. the perception that energy cost reduction was difficult to achieve and unlikely to be worth the effort; and
3. the way energy investment decisions were made in comparison to other investment possibilities.

4.4.1 Intangibility

Of the informants we spoke with who seemed to be particularly interested in reducing their energy consumption, a common theme was their use of a particular item of their business process as a proxy for energy consumption. For example, an ice cream store owner thought of electricity in terms of “keeping the ice cream cold.” A fast-food restaurateur thought in terms of “cents per burger.” Manufacturers thought in terms of units of product produced per unit energy.

All of these techniques addressed the issue of the tangibility of energy consumption. It is a common refrain in the efficiency community that people do not buy energy, they buy the services that energy provides. However, the utility bill does not charge in service units, but in energy units. Making the linkage is an important and logical policy objective in correlating energy consumption and energy cost. Some informants were able to establish this link as described above, but most did not. As a result, they were unable to correlate consumption behavior to energy cost.

4.4.2 Consumption Reduction: Skill, Effort and Value.

Among the informants who were not specifically trained in energy issues, there was a sense that conducting analysis of energy consumption was complex, and that they were not trained to do it. As a result, they felt unqualified to make any decisions about changing energy costs. This feeling even extended to informants whose job was specifically related to energy use. The self-identified “energy manager” of one company had personal friends who ran an energy services company. He had considered asking them about the energy consumption at his business, but decided that the business was not too complicated. He said it did not have any “industrial processes.” Because of this, he felt that there was nothing that could be done.

While it is true that careful analysis of business energy consumption on a building- or process-wide basis can require significant analytical expertise to conduct appropriately, we were struck by the vehemence with which informants claimed that they were incapable of understanding any of the issues involved. We believe that this opinion stemmed from a number of factors.

First, there was a sense that any change in consumption would have to be the result of a complicated process, or it either would already have been done or would not have significant impact. This reflected a bit of the “Lake Wobegon effect”—the fictitious location from Garrison Keillor’s radio show where “all the children are above average.” All of the informants considered their energy use to be generally efficient, so they did not see much opportunity for improvement.

Second, the complex nature of the utility bill (as discussed above) implied to them that the topic of energy consumption had to be a complicated one, and therefore any reduction in consumption would also have to be complicated. However, the complications reported by informants were not always technical in nature. Some informants were comfortable with the idea of changing energy-consuming systems but were daunted by organizational barriers they would face to implementing those changes.

For example, a number of the businesses rented space in a building owned by another party. This creates the well-known split-incentive problem, in which owners have little incentive to invest in energy-efficient equipment, as they do not pay the energy cost, while tenants do not want to pay for capital costs that they cannot recoup if they leave the rented space. Informants in this group were quite aware of this incentive problem, and it directly contributed to their lack of interest in bill consumption information. One informant, a grocer, said that he would have to discuss any potential lighting changes with the mall owner, and that dealing with that was not worth the hassle even though the savings from a lighting change would have “a six-month payback” according to his calculations.

It is important to note that these issues are confined to the realm of investment in capital projects. Some studies have shown that comparative energy consumption information can affect energy consumption behavior, even in the commercial sector; e.g., (Siero, et al. 1996). If the utility bill were to offer comparative consumption information, it might foster the competitive nature that seems to encourage lower energy use through changes in operations practices. Clear correlation between actions and results could also help to reduce this

sense of the overwhelming complexity of the topic. As outlined above, there are validity questions to that comparison that would have to be addressed.

4.4.3 Decision Criteria

Finally, we found that there was a significant difference in the way companies made decisions about investment in energy efficiency compared to other investment decisions. A two-year payback on energy investment was quite standard among the larger firms we spoke with, while smaller firms considered any investment to be beyond their ability to pay. We found numerous instances, of other investments that were not considered based upon a payback criteria. One of the most striking had to do with another type of conservation investment: water conservation. Several informants in large companies reported that they had undertaken significant water conservation investments in their firms because it was the “neighborly” thing to do in their community. Water expenses were not significant, but water conservation was seen as an appropriate stewardship of a community resource.

Similarly, one large manufacturing company had split its energy management efforts into two separate departments: one dealt solely with energy prices, while the other dealt solely with energy consumption:

(INFORMANT): [Consumption and cost reduction] are almost two separate things and it is easier to think of them that way. You think of it this way. We are going to try to reduce our consumption as much as possible, forget the cost of energy right now.

Why did the firm take this stance? They had established a corporate policy to do so:

(INFORMANT): What's happened in the last couple of years though, is we are now focused on sustainable development, which isn't always cost reduction driven. We're looking now at reducing our fossil fuel consumption from a different perspective, not just because it reduces cost; it is almost a fringe benefit of it. The real reason is, because we want to reduce our fossil consumption and emissions from combustion out of fossil fuels. Because for one thing, if you see the patterns, the environmental patterns that are going on right now, businesses, large businesses at some point will not be able to continue business the way they are. And we want to proactively see a correct path, correct ourselves before someone comes along and does it for you. Or before you just can't, before it is too expensive to do business. And that really is the driver as of late what ... why we are trying to hit it up. That's why I like to separate [consumption and cost]. I like to say okay, let's first, not first, but let's become as efficient as we can. And then [another employee] will say let's try to find the best deal we can on our energy.

I now turn to a second component of the utility bill: consumption feedback.

In the next chapter, I will discuss self-comparisons - information about the informant's own energy consumption - and how that information was valued by the informants.

Chapter 5

ANALYSIS: SELF-COMPARISON CONSUMPTION FEEDBACK

In this chapter, I discuss the mechanisms that business decision-makers used to compare their current energy consumption with their energy consumption history. Kempton and Layne (1994) describe two uses of self-comparison in the residential sector: “checking whether consumption is unusual and evaluating conservation actions.” (Kempton and Layne 1994, 861.) This chapter provides an analogous analysis of self-comparison in the commercial sector.

First, I discuss the use of the utility bill as a resource for comparison. Second, I discuss three mechanisms that informants identified for examining their energy consumption. Finally, I discuss specific types of comparative information informants identified as of value.

5.1 Filing the Bill

In general, informants reported keeping some record of their energy consumption over time. The mechanism by which the information was stored and retrieved varied between large companies and all other firms.

5.1.1 Small- and Medium-Sized Businesses

Small- and medium-sized businesses often reported keeping a paper copy of their utility bill on file as part of their business records. One example of this was mentioned earlier in Section 4.2.2 in the response of the church facility manager to the question of how the bill was processed:

(INFORMANT): Then once I have looked at [the utility bill] and I have approved it and I pass it on to ... our bookkeeper, and then she keeps all of the records. And she keeps them for years and years. And so whenever I have a question about what did we do last year this time, she can, she tells me that.

This was a relatively common response. In particular, medium-sized businesses often had a bookkeeper or accountant who filed all financial data, and the utility bills were considered part of this record.

Smaller customers also usually filed their bills, though the filing system was perhaps less defined than the financial/accounting format of the medium-sized companies. Sometimes these smaller business decision-makers did not keep the bills. The informant at a furniture store illustrates both issues:

(INTERVIEWER): ...so do you store these bills someplace?

(INFORMANT): Uh huh [affirmative].

(INTERVIEWER): So you file them all. And do you go back and take a look at them sometimes?

(INFORMANT): Oh, occasionally. You know, at the other place I did. I've been hanging out with [the store owner] for a little over two years, so there's old stuff I could look at. She didn't keep a lot of records prior. If they were paid, she'd toss 'em. But it's just kind of nice to have a collection of paper.

When I asked one small business informant why he chose to keep the utility bills, he reported that he was not sure, but it seemed like the right thing for a business owner to do. In general, informants seemed to view keeping the bills in this way as a prudent business activity. The owner of a liquor store identified this explicitly:

(INTERVIEWER): ...how long do you hold onto the bills? Do you throw them out?

(INFORMANT): No, I have them for three, four, five years. That is an accounting process and it goes into the file.

5.1.2 Large Businesses

Large business informants were the exception to this filing process. As I described in Section 4.2.2, the utility bills for large businesses were often handled by an accounting department. As a result, informants from large firms had often devised internal systems to collect data about the firm's energy consumption. A large manufacturing facility in Boston, for example, paid \$500 every six months to receive an electronic data file of fifteen-minute energy consumption data for the facility from the utility company. Another manufacturing firm in the greater Boston area had its security guards read electricity meters as part of their daily rounds and report the information to

the energy manager. These data were kept in computerized records, typically spreadsheets.

In general, business decision-makers had some form of prior energy consumption information available to them through these record-keeping processes. How, then, did they use this information?

5.2 Self-comparison

Although a number of informants reported that they never looked at their utility bill beyond paying the amount due, almost all of the business decision-makers interviewed used some form of self-comparison when considering their bill. In other words, decision-makers did take some useful information away from the utility bill, even if only the dollar amount of their monthly consumption. Three distinct forms of self-comparison were revealed in the interviews:

1. intuitive comparisons, in which the informants compared the utility bill amount to a reference amount in his or her head;
2. budget comparisons, in which the informant compared the amount due to a specific amount explicitly budgeted for utilities that month; and
3. historic comparisons, in which the informant compared the amount due (and occasionally the kilowatt hour consumption) to prior months.

Each of these types of comparison is described below.

5.2.1 Intuitive Comparison

Kempton and Layne (1994) write that residential customers go through a process by which unusual bills are identified and considered. Informants in my research also reported a consistent set of steps they used when considering the utility bill. First, as described earlier, they would focus on the amount due; i.e., the dollar value of their energy bill. If the amount seemed unusual to them, they would try to seek out more information to confirm that the bill really was unusual. Finally, if they confirmed the bill as out of the ordinary, they would try to determine a reason for the discrepancy. This printing-plant owner described the process quite succinctly:

(INFORMANT): I would say that no one looks at [the bill] unless as a number, as a billed amount, if it appears to be unusual for any reason, very high or very low. So if there is something that does not track with the historic consumption of our plant ... if it seems out of budget than it will be looked at, otherwise if it falls within budget we will proceed, just process the invoice.

The determination of whether a bill was very high or very low was often made based on the prior month's utility bill. Sometimes the comparison with the prior month was not solely for comparing energy cost or consumption, as this day-care center informant illustrates:

(INTERVIEWER): When the bill comes in the mail, what do you do with it?

(INFORMANT): I usually check with the previous month here, so that, sometimes I haven't paid, so that I can pay, and then I register it. But that is all I do. I don't really read it carefully. First of all I am

very stingy on time like that and then if the two just not ... from the previous month, I just let it go. I don't really analyze it.

(INTERVIEWER): So you get the bill and then if it is not too out of whack you just pay it?

(INFORMANT): Right.

This issue of whether or not the prior month's bill had been paid came up several times. Some businesses would wait until the last possible date to pay the bill. The informant at a furniture store explained his reasoning for doing this:

(INFORMANT): Well we just, we glance at [the bill] and it just gets paid in its normal rotation, whatever, as late as I can possibly get away with.

(INTERVIEWER): You know, that's interesting in itself. Some businesses have these sort of set schedules where they pay everything on the 15th or the 30th, and some people pay it as soon as it comes in, and some people push it to the due date.

(INFORMANT): Yeah, well, we push it pretty good, because there's very few penalties, you know, there's penalties in the other bills, but there's not too many penalties for pushing your luck with these guys.

While the decision-makers were comparing their utility bill with the prior month based on price, some would factor in other variables, as this retail sales store informant did:

(INFORMANT): I open [the bill] and look at how much I pay, and when you look at the amount you spend you know if you spend too much, just by looking at it. It depends on the weather. Like

now we just have winter, it is messy, you gonna have a lot, the money is going to be a little higher. But if the weather is good.... I look at how much I paid last month, particular, if the weather stays the same, I look at what I paid for last month. And if it looks like it is the same and you see how much you used, you are able to compare.

In these circumstances, informants usually reported that they would call the utility company if the bill seemed high.

5.2.2 Budget Comparison

Some informants, particularly the medium and large businesses, had an additional point of comparison they used: a utilities budget. If the numbers in the utility bill did not match their budgeted amount for the month, they would notice. Often these comparisons would not come from the utility bill itself, but from monthly or quarterly budget statements that would show utility costs out of range with the budgeted amount. In these circumstances, informants reported that they would either take conservation actions to try to reduce the cost or, if they felt that there was nothing that could be changed in their business practice, simply bear the cost. No informants reported taking action based on bills lower than budgeted.

The budget comparison, similar to the weather comparison above, allowed the decision-maker to justify higher utility bills that the prior month comparison alone would allow. In other words, a sharp jump in energy cost might not be considered unusual if it could be explained, either because of weather conditions or because of expected seasonal variation. As will be discussed

below in the section on preferences, this seasonal variation was something most informants recognized as important.

5.2.3 Historic Comparison

Finally, some informants compared their current bill to bills several months or years in the past. To do so, they made use of the files they had kept of their bills.

The owner of a private school described the process this way:

(INFORMANT): Like this last month our bill was quite high. And so I went in to ask her to check and compare it with last year's, compare it with last month's, which she did, and actually it was about the same last year so I had forgotten. It was about twenty-five hundred dollars.

Many of the informants had some form of self-comparison already on their bill – a comparison of their current month's bill with the same month's consumption the previous year, or even a rolling twelve-month history of their energy consumption. It was uncommon that informants would report making use of these. The feedback that many informants were already receiving was not seen as particularly helpful. I believe one reason this was the case was that the comparisons were presented in kilowatt-hour figures, and the business decision-makers were accustomed to making their consumption comparisons based on cost.

Larger businesses, those that had full-time energy managers, were also relatively unimpressed with the idea of historic comparisons, primarily because they were already collecting that data for themselves. In most cases, the larger firms had

spreadsheets that tracked their energy consumption over many months, often including the information they had collected themselves (as mentioned above) at a level of detail finer than the monthly information on the utility bill. Therefore, the monthly data that they were currently receiving on their bill was generally considered to be of limited value to them.

At the same time, though, data at an even more aggregated level than monthly utility data was sometimes used by large business decision-makers. For example, an insurance company facility manager showed me a bar graph that showed ten years worth of annual consumption data, divided into summer and winter consumption, with specific construction milestones noted in each year. This graphics was used to demonstrate the energy consumption impact of certain features in each building as it became occupied or was decommissioned. For example, a reduction of roughly one gigawatt-hour of annual energy consumption was labeled, “Decommission Computer Room.”

5.3 Historic Comparison Preferences

In the abstract, self comparisons were often mentioned as something that would be of interest to the informants. However, in the cases where self-comparison information was already available, the informants found it sub-optimal. While they expressed interest in self-comparison information generally, they identified current implementations as inadequate. Informants suggested three major types of improvements.

5.3.1 Time Period

Several informants suggested changes in the time frame of comparison. This took two forms. Those who were already receiving a comparison that showed their current energy consumption and their energy consumption in the same month of the prior year said that a longer time frame would be more useful. They wanted to see several months of prior consumption so that they could determine trends. Informants also suggested that monthly comparisons were too frequent. In both cases, the seasonality of energy consumption seemed to be a strong element driving their comparisons, as this retail store owner illustrated:

(INFORMANT): [Providing comparative information] would be better, because then you know it is true, and you see something to compare with and it didn't change. If they do it every two to three months, which is winter, spring, fall, you would be able to see what you are using. Are you using, like I said, you forget the next year. Sometimes you remember what you used, but it would be nice if they would put it there every three months ... every other month or every three months.

5.3.2 Consumption Projections

Another use of self-comparison data that was suggested was projection of future costs. Informants expressed interest in development of a projection of future consumption (and therefore cost) based on their prior consumption history. Small businesses in particular were interested in this as a budgeting measure. They wanted to be able to anticipate cost increases that might occur, as the cash flow of the business could be adversely impacted by an unanticipated increase in their utility cost.

5.3.3 Graphical Display of Information

Finally, informants expressed interest in receiving information in a graphical format. This owner of an exercise studio combined interest in graphical information and weather correction:

(INTERVIEWER): Do you think it would be interesting if you had a comparison on the bill?

(INFORMANT): Yes, if there was some sort of graphical representation, or bar, or just anything that could say, well, this is what you did last year. Now I know that is going to be influenced by the weather, and obviously, especially in the wintertime or in the summer as to the weather conditions. ... I mean, if we had the same conditions and I had a graph of the weather and compared that with a graph of my demand or my use, then that would be very, extremely helpful.

5.4 Flaws with Current Utility Bill Implementations of Self-Comparison Feedback

By and large, then, none of the informants indicated that the current method of displaying self-comparison data on their utility bill was very useful. Most, in fact, had to be prompted about it as a component of the bill before they would mention it. In most cases, historic consumption information was provided as a text table that showed a comparison of the current month's energy consumption to one of three options:

1. the prior month's consumption,
2. the same month from the prior year's consumption,
3. both prior month and same month prior year.

Regardless of the comparison used, informants did not seem to process the information presented on the bill as useful comparative information. They seemed to lose the data among all the other numbers provided. As mentioned earlier, many informants felt that the bill was too cluttered with text and therefore ignored most of the information presented. The comparative information text seemed to get caught up in this “clutter” and largely ignored.

This problem could be exacerbated by typographical and layout issues. The comparison information was sometimes presented in a format and location on the bill that was very similar to the billing information. For example, the typeface of the comparative information might be identical to the typeface of the billing information, making distinction between the two less obvious. As a result, it was easy for informants to overlook. An example of this is shown in Figure 5.1 below.

Electric Details **Non-Summer rates in effect**
Large General Service - TOU - Schedule GL
Billing period: Nov 12, 1998 - Dec 15, 1998 **Days billed: 33**

Demand Charges			
Non-Summer	Current	Rates	Amount
Prod / Trans KW	191	6.40	1,222.40
Distribution KW	194	2.67	517.98

Energy		Multiplier		100	
Meter read on Dec 15				Meter # G095954833	
Non-Summer	Current	Previous	KWH	Rates	Amount
Peak	3496	3276	22000	.03459000	760.98
Intermediate	2433	2252	18100	.03090000	559.29
Off peak	2743	2527	21600	.02033000	439.13
Customer charge					110.00
Fuel cost		61700 KWH	x	.01128000	695.98
State surcharge		61700 KWH	x	.00015000	9.26
Local tax				3.91%	141.14

Figure 5.1

Example of a suboptimal historic comparison display (Baltimore Gas & Electric, MD)

Total electric amount **\$4,456.16**

Electric Usage Profile					
Month/ year	Type of reading	Days	KWH	Avg daily use	Avg temp
Dec 98	Actual	33	61700	1869.7	48
Nov 98	Actual	28	60000	2142.9	50
Dec 97	Actual	30	54300	1810.0	40

The comparison data available on this bill is actually more comprehensive than many of the informants received. Providing average temperature information is something that several informants mentioned as a preferred element. Nevertheless, the problems with the “clutter” of the bill negated the effectiveness of this information.

In contrast to text-based comparisons, informants seemed to react more positively to graphical representations of comparative information. Several informants (primarily large business decision-makers) had created bar graphs

of their energy consumption each month and used this graphical representation of the data to seek out patterns or unusual entries. One informant received comparative information in a bar graph form on the utility bill (as will be discussed in detail in the next section) and found that data very useful. Informants that had graphical representations of their energy consumption seemed more engaged with the data and likely to use it to inform consumption decisions. This is consistent with the findings of Komor and Kempton (1991), who found, “Our graphs clearly provided new insight on [the informants’] equipment and business operations....” (Komor and Kempton 1991, 124.)

Overall, it seems likely that current implementations of historic data are not as effective as they could be, and that careful attention to the design of such comparisons could provide more effective information.

5.5 Example of a Better Bill

One informant, the decision-maker at a bakery in Niagara Mohawk’s service territory, received a utility bill that included a graphical display of historic consumption information. The energy and cost information section of this bill is shown in Figure 5.2 below.

Electric Service

Niagara Mohawk buys low cost energy that includes hydro electric power purchased from the New York Power Authority. These hydro purchases have a savings value of \$ 47.78.

This meter reading, Feb. 9, 99 (actual)	86429
Last meter reading, Jan. 12, 99 (actual)	73467
Amount of electricity used	12962 KWH

Current charges for 28 days - residential service (RATE 1C)

Basic service charge (not including usage)	\$ 35.18
On Peak Chg 1204 KWH @ 21.0257 ¢	253.15
Shoulder Pk Chg 3327 KWH @ 11.6071 ¢	386.17
Off Peak Chg 8431 KWH @ 7.2051 ¢	607.47
System Benefits Charge	8.37
Fuel adjustment @ .0000 ¢ each KWH	.00

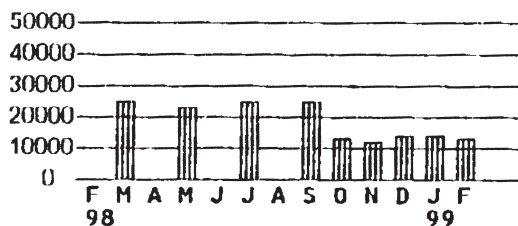
Total cost for time of use service \$ 1,290.34

Your energy use and cost

▨ = Actual reading
 ▩ = Estimated reading
 ▨ = Customer reading

This chart shows your energy use pattern over the last 13 months.

KWH - Electric Meter - 562



Daily Averages:

	Last year	This period
KWH	462.9	
Cost \$	46.08	

Figure 5.2

Example of enhanced self-comparison format (Niagara Mohawk, New York)

This utility bill provides many of the components that informants had expressed interest in receiving. It provides the information in a graphical format, and it provides information about both kilowatt-hour consumption and dollar cost (though the comparison to the prior year is missing in this example.) In the early time period displayed in the graphic (February through September), information was provided on a bimonthly basis. (The business in question only had their meter read bimonthly until the utility changed to a monthly billing cycle part-way through the time period in question.) A missing element is weather data - none is provided in this example. Overall, though, the graphical display and cost information are unusual compared to the bills most other informants received. These features seem to meet nicely some of the preferences expressed by respondents.

In addition, this bill provides a good example of solutions to some of the other bill formatting problems discussed earlier. The meter reading information in the upper right provides the last-month/this-month readings in a layout that makes clear that the subtraction of last month's meter reading from this month's provides the electricity used during the month. The comparison graphic is also clearly set off from the billing information by the dark line dividing the two sections of information.

Perhaps it is simply coincidental, but the small bakery that received this bill was one of the most energy-conscious businesses of those interviewed. The decision-maker had often interacted with consultants to improve the energy performance of the building in which the bakery was located, in one case going beyond the consultant's recommendation to super-insulate the basement area.

They had volunteered to participate in a time-of-use tariff and actively shifted consumption to off-peak hours. They actively used this comparative information:

(INTERVIEWER): Do you compare your usage internally, with last month or last year?

(INFORMANT): Oh yeah... any time it is a big change we go back. ... You [can] see at a glance right away.

The informant goes on to describe (in a way that is rather disjointed to quote directly) how the comparative information was used to identify an unusual rise in energy consumption. Ultimately, the informant traced the increase to a problem with the oil furnace used for space heating.

5.6 Conclusion

In sum, businesses maintain records of energy consumption, the decision-makers use those records to create expectations of “appropriate” energy consumption for the business, and deviations from the appropriate consumption level will cause some examination of the records.

When informants were asked about the concept of using their utility bill to compare their current energy consumption with their history of energy consumption over time, they were in favor of having this information. However, current implementation of this feedback on the utility bill is not as effective as it could be. Several informants received historic consumption information on their utility bills, but they generally overlooked this information. The text-based format

of the comparison seemed to lead the informants to overlook the comparative information provided. Utility bill historic feedback information could be improved to provide the information informants prefer. Two improvements to the time frame of the feedback were suggested:

1. Comparison over several prior months rather than simply the previous month.
2. Comparison of longer time periods than one month; e.g., seasonal comparisons like “this winter compared to last winter.”

Informants also expressed a preference in projections of energy consumption for the future and for graphical consumption feedback.

In at least one case, a utility provided graphical consumption feedback information that met some of the time frame criteria informants had expressed for improved feedback information. The informant receiving this graphical display was active in controlling energy consumption and had used the display to identify problems with equipment. Informants who had created their own graphical displays also used them to identify opportunities for efficiency improvement in their buildings.

These results suggest that better self-comparison information could be useful to business decision-makers. Decision-makers develop a mental model of expected energy cost based on their utility bill history. They keep records of their utility bills, and they refer to those records if a bill seems unusual compared to their mental model. If their records confirm that the current bill is unusual, business decision-makers will try to seek out additional information

to identify why that is the case. Small-business decision-makers turn primarily to the utility company to provide explanations of high bills. Decision-makers in mid-sized businesses may also turn to outside contractors or consultants for advice. Large-business decision-makers usually depend upon their own expert knowledge to determine reasons for variation.

In all of these cases, improvements in the feedback provided by the utility bill could enhance the visibility of historic comparison information. Improved visibility and applicability to the business decision-maker's decision-making context could make more business consumers aware of the impact of their energy consumption choices on their energy cost and active in their behavior to control it.

Chapter 6

ANALYSIS: GROUP COMPARISON CONSUMPTION FEEDBACK

While the results of the previous chapter suggest that better self-comparison information could be useful to business decision-makers, one of the flaws with self-comparison is that it does not necessarily identify opportunities for saving energy within the firm. Once a business decision-maker has established a set of expectations based on self-comparison, that level of consumption is seen as normal, even if significant efficiency potential exists in the business.

Group comparison consumption feedback can help provide decision-makers with information about efficiency potential by demonstrating the actual range of energy consumption members of a group are experiencing. Members of the group at the high end of the range may then observe that using less energy is possible, revealing the opportunity for improvement. In this chapter, I first review the theory of group comparison consumption feedback, discussing why it seems to offer potential for encouraging changes in behavior to reduce energy consumption. I discuss several observations of energy consumption comparisons made by informants. I then discuss informant attitudes toward the idea of comparative energy consumption feedback provided by the utility. I conclude with a discussion of some of the implications of these findings.

6.1 Review of the Theory

Group comparison consumption feedback offers the opportunity to provide feedback recipients with a sense of achievable energy savings potential.

Group members whose consumption is low compared to a reference group are encouraged to maintain their consumption, while group members on the high end of the reference group have the opportunity for lower energy consumption demonstrated to them.

Research associated with the Energy Star Billing program has examined the implementation of comparative consumption information in the residential sector. Evaluation of two utilities implementing this type of feedback on residential utility bills shows that informants like the concept of being compared to similar residences (Eide et al. 2000). The research has also shown that the type of information provided can be very important:

Success of customer-focused efficiency programs is to a large extent limited by the design of information provided to the customers. It is easy to fall prey to creating bill information that makes sense to an analyst, but not to the average utility customer. (Iyer et al 2006, 2)

As discussed in chapter 2, Katzev and Johnson (1987) reviewed three forms of behavioral intervention strategies: (1) antecedent information, (2) consequence feedback, and (3) social influence. A utility bill providing information about self-comparison and group comparison consumption feedback could provide all three of these techniques at the same time:

1. Antecedent information could be provided by information on the bill about the potential for saving energy. Self-comparison and group comparison could allow the utility to target customers that are unusually high in their energy consumption. (Iyer et al. 2006 offers specific statistical methods of identifying such customers through analysis of utility billing data.) These high-potential customers could then be targeted with information about their energy savings opportunities
2. Self-comparison consumption feedback could provide information about the consequences of customer actions taken to alter energy consumption. Chapter 5 discussed some examples of how this information was already being used, albeit not as effectively as it could be.
3. Social influence could be provided through comparative consumption feedback. If recipients of comparative feedback consider themselves to be part of the group to which they are being compared, social pressures could come into effect. For example, discussion of the relative ranking of group members on a comparative consumption graphic could develop a form of competitive pressure identified by Siero et al. (1996.)

Komor and Kempton (1991) note that an important component to providing comparative consumption feedback is the perceived validity of the data provided. “Information that was strongly inconsistent with prior beliefs was viewed with suspicion....” (Komor and Kempton 1991, 123). The validity of this comparison with “like” consumers, or peers, seemed to be an important issue. Who, then, would commercial customers view as their peers?

My hypothesis was that small commercial customers in particular would have several potential peer groups available to them. One group might be neighbors—other small businesses in the vicinity. For example, one can imagine that the owners of small businesses in a strip mall might talk with one another. Because they shared similar equipment types and similar business sizes, they

might be better able to distinguish the impact of specific energy consumption behavior on their relative energy use.

Another group might be businesses of a similar type—dentists might belong to a local trade association or other organization of dental professionals. Such an organization might be able to easily compare the energy consumption of equipment choices unique to their profession.

A third group might be membership in a more general organization of small business owners—for example, a local chamber of commerce. Members of such an organization would have a familiarity with the other members and would potentially be able to evaluate the known behavior of specific members with their likely energy consumption relative to the others. A member who considered herself an energy conserver relative to the other group members might be motivated to act if a comparison of her energy consumption showed that she was similar to the other members.

Given this hypothesis, what energy comparison activities, if any, did my informants report?

6.2 Comparison Activities

Several examples of energy consumption comparisons were mentioned by informants in my interviews. They took two forms:

1. comparisons within firms, in which a decision-maker would have access to utility bill information from several sources within the firm (e.g., multiple meters); and
2. comparisons among firms, in which a decision-maker would have access to consumption information from other firms.

Each will be discussed below.

6.2.1 Comparisons Within Firms

Several business decision-makers discussed comparing the energy consumption of the business in which the interview took place with other businesses they owned. These comparisons occurred most often with hybrid businesses. These were businesses in which one business owner owned several small businesses.

For example, one informant was the owner of several fast food franchises. He reported that he had compared the utility bill of one outlet that had received a lighting upgrade with the bills of his other outlets that had not received an upgrade. His comparison convinced him that the lighting upgrade was effective in saving money, so he implemented the lighting upgrade in all of his stores.

The owner of several dry cleaning stores had a similar bill comparison process. He would compare the bills he received for each of his dry cleaning stores. If the cost of one of the bills was significantly higher than that of the other stores, he would try to determine why that was the case. In describing this process to me, he described one experience in which he had identified a high utility bill. He

attributed the high bill to equipment operation issues in a store and surmised that an air-conditioning system had been left on during times when the store was supposed to be closed. In this, his response was highly reminiscent of Komor and Kempton (1991) when informants in their study were shown monthly, daily, and hourly plots of energy consumption. In contrast to Komor and Kempton (1991), this informant drew a conclusion from monthly data that Komor and Kempton associated with hourly plots. Komor and Kempton report:

A contractor pointed to an hourly fluctuation and noted, 'Somebody screwed up here ... things are staying on. What's this peak on Monday? Must be air conditioning.' [Komor and Kempton 1991, 124].

The informant interviewed in this study nearly echoed that conclusion in discussing his high-bill issue when he said that he had thought, "Maybe someone left the AC on."

Large firms also made comparisons within the firm about energy consumption. Several informants from large firms showed me graphical comparisons they had generated from their own energy consumption data to demonstrate energy consumption in each building of a multi-building environment. These decision-makers usually developed an intuitive sense of the "appropriate" energy consumption patterns of each building based on prior experience with the relative energy consumption of the group. If one building started to change its energy consumption position relative to the group, the decision-makers would focus their attention on that building to determine what was causing the change.

Another topic of interest to large firms was the idea of “benchmarking” or “metrics.” As was mentioned in Chapter 4 in the discussion of Intangibility, firms would often try to create metrics by which they could quantify their energy consumption. One large manufacturing firm measured its energy consumption in Btus per unit of product produced. This would allow the decision-maker to make consumption comparisons across production lines.

In general, small business decision-makers did not report making these kinds of comparisons. This is likely because they did not have the data available to them to allow them to do so. By definition, a business decision-maker at a store in a single location did not have another business against which to make a comparison. In a few cases, the decision-maker did make a comparison against an additional data point with which he or she had familiarity — their residential energy bill. In that case, the comparison often led to a discussion of actions to take at home rather than at the office. This dentist explains:

(INFORMANT): For me [the utility bill] is never [an issue], I think [my wife] and I, we are more worried about out home bill. Not the office bill, because we have a lot of control over [the home bill]. And I know if I overuse it and be paying a lot of maintenance, and this sort of thing, so I work carefully. But here, a patient walks in and they don't want to be hot, they don't want to sweat. ... [Y]ou need to have it comfortable and that is more of a concern to me.

Medium-sized business decision makers had little to say about energy consumption comparison within their firms. Although these businesses might have multiple buildings, they were often on a single utility meter. It was therefore

impossible for the decision-maker to break out the energy consumption by building. The facility manager at a church explained this phenomenon:

(INFORMANT): One of the things that I struggle with is that the complex of the church here is ... you know, we have the administration building, we have a classroom kitchen building, we have the [day care center] and we have the church sanctuary itself. And they are all on one system.

(INTERVIEWER): One meter?

(INFORMANT): One meter. Okay, I can't differentiate who is using what when. And so if I am having an abnormal cost day, or cost month, I don't know where it is coming from. I can kind of guess, but I don't have specifics on that. So that has been my problem in trying to figure out, do we want to re-meter everything...?

The inverse of this situation was true, too — a decision-maker might have multiple utility meters but not be sure what loads were connected to which meter. As we saw in chapter 4, the private school owner had this problem:

(INFORMANT): Well, I mean I look up at the address and tell which one goes up there, but for some reason or other we get more than one bill for this building and I've never been quite clear why that is.

In sum, medium sized businesses were caught in a grey area: too small to have large loads on separate meters that could be compared, and too large to be comparable to residential bills.

6.2.2 Comparisons Among Firms

Another form of comparison was comparison among firms rather than within firms. One example of this was provided by the informant at a furniture store, who provided something of a self-comparison/group comparison hybrid response. He was able to compare the energy consumption of the business in its current location with the consumption from a prior business location:

(INFORMANT): We just moved in April, so we're just getting experience with a new set of bills, and the bills were running a hundred bucks or less at the previous building. At this one, it'll run a hundred-fifty to two hundred. So it'll take a little more examination.

(INTERVIEWER): Just bigger, or ...?

(INFORMANT): Yeah, a lot bigger. Over twice as big a space. And the means of heating and cooling are the same. Swamp cooler and this hanging down heater [gas]. There's a little better thermostat here. The unit's somewhat newer, but not dramatically so.

A comparison more along the lines of my original hypothesis took place between two auto service firms that were located near each other. Because the two store owners spoke with one another, they were aware of each other's energy consumption:

(INFORMANT): Yeah, [the other store owner]... his [bill] is higher than mine. I think he is higher, because I don't really look too much.

(INTERVIEWER): But you have talked about it with him?...

(INFORMANT): Yeah.

The corresponding business owner said this:

(INTERVIEWER): ... Since you talk to [the other store owner], you know what you are spending?

(INFORMANT): Yeah, for example, mostly we spend the same. For example the fan on the top, they use \$500 a month and the same with me....

One of the business owners knew that the other owner used his air conditioning throughout the facility. The first owner, by contrast, did not use air conditioning as much and only cooled his office, not the whole space. As a result, he knew that his bills should be lower than the other store owner's bills during the summer.

Based on the responses above, there seemed to be some group comparison activity already taking place. Business decision-makers were comparing their own consumption within firms, and some decision-makers were discussing their energy consumption with similar firms. At least one informant had even reported making energy-efficiency investment decisions based on this comparison. All of this suggested that business decision-makers would be quite amenable to receiving comparative consumption information on their utility bills. So how did they respond when I posed the question directly?

6.3 Attitudes Toward Comparative Consumption Feedback

Given the above, one would expect that the response to my direct question, “Would it be helpful to you to be able to compare your business to other businesses like yours?” would be a foregone conclusion. As a result, the responses I received were almost completely unexpected. With very few exceptions, informants were very negative toward the idea of comparing their energy use with the energy use of another business. Small business decision-makers were particularly negative. Large business informants were somewhat more willing to consider comparative consumption information as something of value.

6.3.1 Small-Business Informant Attitudes

From an analytical perspective, one might hypothesize that comparative consumption information would be particularly useful to small businesses. First, most smaller businesses do not have significant process loads, so it is an easier analytical task to compare the major consumption elements among different businesses. Second, several small businesses we spoke with were located in strip malls, where the utility services available, and often the hours of operation, for each business were essentially the same—the major variation would be square footage. Finally, some informants were franchise operators, and those franchises had relatively standardized floor plans, equipment installations, etc.

Given all of these factors, the vehemence with which the informants from smaller firms rejected the validity of “like business” comparison was surprising.

There was significant resistance to the idea that any business could be like their own, and any comparison that would be done would not therefore be on an “apples to apples” basis. Informants had a hard time believing that any accurate comparison could be possible.

Ironically, this response was even true for the hybrid business informant mentioned above — the fast food franchise owner. While he reported that he had made comparisons among his own stores and taken actions as a result, he felt that any comparison with other fast food stores (of the same national chain) would be meaningless. He argued that there would be too much difference in customer traffic for a comparison across such stores to be meaningful.

6.3.2 Medium-Sized Business Informant Attitudes

Informants from medium-sized firms were also quite concerned about the validity of comparing their energy consumption to the consumption of other firms. While the informants seemed to be somewhat more open to the concept, they were adamant that creating an appropriate comparison would be extremely difficult. Issues most often raised included the type of business, the hours of operation of the business, and the type of equipment used by the business. The idea that any of these might be different from their own business caused the informants to believe that a comparison would be meaningless.

6.3.3 Large-Business Informant Attitudes

In contrast, large firms did express interest in “like business” comparative information, even though they recognized that the comparison would have to be very rough. Their concern was on an “order of magnitude” basis – they wanted to make sure that nearby companies had not found significant process or price savings that their own company had overlooked. As the owner of a printing plant said:

(INFORMANT): Comparing us to an industry even regionally or nationally is a tremendous help. I don't think any of your local utilities would want to engage in that, because then they are being held up to standards that are nationwide, as opposed to local. ... I would find it interesting, but I am not sure they would.

This informant went on to describe exactly the behavior hypothesized if one were to receive such information:

(INTERVIEWER): If you would be in the middle range, do you think anything about it, if you would be at the high or low range?

(INFORMANT): Sure, if you are in the middle, you are going to make the assumption that, you know, nothing is terribly broken, so you don't need to fix it. If you are very high, I think that would be a flag to investigate why. If you are very low, I think you'd be happy and not say anything.

The point this informant raised about utility company disinterest in the concept was one that was raised fairly commonly among large customers. While they were interested in receiving comparative feedback information even if the

comparison were rather rough, they often reported that it would be difficult or impossible for a utility company to provide such information. Crossing multiple utility service territories was mentioned several times as a barrier to providing this information, as the informants did not believe that the utility companies would be willing to share data.

One informant, the facility manager at a small college, did mention a way around this:

(INFORMANT): ... We are also part of APA, which is Administration and Physical Plant and Administrator [sic], which is a national organization, and we are constantly doing cost-comparisons across the board, whether it is maintenance or whether it is utilities and so forth. So we have that report on a regular basis.

(INTERVIEWER): So you actually do compare your energy use with other colleges in the area?

(INFORMANT): Yeah, I haven't sat down and reviewed something like this with another school, no. I guess, to answer the question, well, no we don't make a lot of comparison. It is all done on utility cost per square footage which everybody publishes, but how closely we are in terms of calculation, we live in the same parameters, that is difficult to know.

While the comparison was somewhat rough from an analytical perspective, it was still being made.

6.4 Conclusion

Overall, the response to group comparison consumption feedback was inconclusive. On the one hand, several business decision-makers seemed to be already taking steps that would indicate peer group comparison of one form or another. Business decision-makers were discussing their energy use among themselves. Decision-makers with multiple bills were comparing them against one another. Larger businesses had developed metrics for internal comparison and created graphical representations of their energy consumption to help guide energy investment decisions.

At the same time, almost all of the informants were dubious of the ability of any comparison with “like businesses” or businesses in the area to provide valid information. Small business informants were particularly vehement in expressing their belief that no comparison to their business would be valid.

I believe there were two issues that contributed to this response. The first was the fact that none of these businesses had experience with receiving an actual utility bill that provided group comparison consumption feedback. Their reactions to the idea, more so than to any of the other questions in the interview, were not based on any experience with such information. It may have been easier to say, “Well, that won’t work,” than to say, “Well, I’ve ended up using this in this way....” Implementation of an actual comparative feedback program would help identify whether the concept would be discarded in practice or adapted and used in some form.

The second issue that I believe contributed to such a strong negative response among the small-business decision-makers is speculative, but interpreting the reaction of informants during the interviews using this hypothesis seemed to provide an accurate description of informant behavior. Most of the small business decision-makers considered their businesses utterly unique. My hypothesis is that, in the highly competitive and failure-prone world of the small business entrepreneur, it is an important component of self-identity for the business owner to convince him or herself that he or she is unlike other business owners and will therefore be successful. To accept a comparison with another small business would erode this sense of uniqueness, placing a higher level of uncertainty on the viability of the business.

This hypothesis would explain, for example, the seemingly dubious response of the fast-food franchise owner that his stores were completely different from other stores franchised from the same parent corporation. It is difficult to imagine from an objective energy analysis standpoint how such standardized structures could be considered so dissimilar. Energy-consuming systems in these stores are virtually identical, as they are all provided by the same corporate supplier. Employee training in the operation and maintenance of the facilities is consistent throughout the franchise operations. Operating hours are typically quite similar. What, then, would lead the informant to reply so stridently that no comparison with the stores of other franchise owners would be possible? Furthermore, why would comparisons among his own stores be acceptable? The response seems consistent with the challenging of a strongly-held belief. This example is a very clear case in support of the need for more behavioral research in the commercial sector, as the belief structure within which

these actors operate is a key component determining their consideration of behavioral choices.

In contrast to the small-business decision-makers, large business informants were more willing to accept consumption comparison, even though the underlying technical analysis was less valid from an engineering standpoint. Smaller businesses that could potentially be compared in a technically sound manner were less willing to accept the validity of the comparison. Any mechanism to provide comparative consumption feedback to small businesses will have to deal with this paradox.

The last section of my interview protocol dealt with sources to which businesses turned to get information about their energy consumption and changing their energy use. Chapter 7 provides an analysis of the responses to this set of questions.

Chapter 7

ANALYSIS: SOURCES OF INFORMATION

The last section of my interview protocol dealt with information sources business decision-makers used to get more information about how to change their energy consumption. One reason for examining these information channels was to identify potential alternatives to the utility bill as an information delivery mechanism for comparative consumption feedback. The hypothesis was that businesses that were part of a national chain (like the fast-food franchise owner) or were part of a specific trade association (like the printing plant owner) might see those organizations as trusted sources of information. At the time these interviews were conducted (1997-1999), Web-based information presentation was just beginning to be fairly widely available. The dot-com boom was in full bloom, and a number of companies were discussing the idea of presenting information to business customers over the Web. I wanted to learn to what degree Internet access was even available to small business customers and to what degree Internet information was utilized by business decision-makers generally.

This research was also conducted during the early development and implementation of the Environmental Protection Agency's (EPA) Energy Star Building Label program. EPA was interested in examining to what degree awareness of the Energy Star program had penetrated the commercial sector

and whether EPA was seen as a credible source of energy efficiency information. I discuss the findings from these questions below.

7.1 General Sources of Information

As with the responses to other questions, responses to the question about sources of information tended to be correlated with business size.

7.1.1 Small-Business Informant Sources of Information

Small-business informants almost exclusively identified the utility company as their primary source of information for more information about energy use. Most small-business informants associated this directly with questions about the utility bill. Several reported calling the utility when a particular bill seemed high. The inquiries were transaction-based, not behavior-based. In other words, the interaction between the small business owner and the utility was typically over the accuracy of the bill, not seeking information about how to reduce energy consumption. This finding is consistent with general attitudes about energy consumption mentioned in Chapter 4. Small business decision-makers often expressed a sense of inevitability about energy consumption and a corresponding inability to alter it significantly. As a result, the idea that the utility company could offer alternatives to their current consumption patterns was typically not considered.

In response to questions about high bills, some informants did identify contractors as someone to whom they would turn for more information. High

bills were associated with equipment, particularly space conditioning equipment, not working properly. In such cases, a service contractor would be called in to determine if the equipment were functioning properly.

7.1.2 Medium-Sized Business Informant Sources of Information

Decision-makers in medium-sized businesses reported a similar interaction with the utility company, using a similar transaction-based interaction model. Because these businesses were often on more complicated rates, questions about the tariffs were a larger component of the discussion. Informants in these businesses reported discussions with the utility to make sure they were on the correct rate schedule, as more options were available to them.

In addition, informants at medium-sized businesses were more likely to mention the idea of consultants of some kind. Several mentioned that technology salespeople (for example, a lighting salesperson) called on them relatively regularly and provided information about energy consumption for those technologies. This information was regarded with some level of skepticism, but it was an additional source of data that was largely unmentioned by small business informants.

The comparison of utility information to information provided by salespeople is instructive, as informants did not give the two sources of information the same weight. The utility was generally seen as an unbiased source of information, although there were several informants who raised complaints about the monopolistic nature of utility companies. There was a general sense of

fatalism about the cost of electricity in these responses, but the veracity of the information the utilities would provide was never questioned.

Information from salespeople, and to a lesser extent service/maintenance people, was considered as inherently biased. While informants reported that they had received useful information from such sources in the past, they also reported a degree of skepticism in interpreting the information.

7.1.3 Large-Business Informant Sources of Information

Large-business decision-makers reported turning primarily to specialty consultants, either in-house or outside consultants hired for the purpose, for information about energy consumption options. At this level, the interaction between the utility and the business as a business transaction was handled by a separate entity than the informant, so it is not surprising that they would be more focused on energy consumption rather than energy cost transaction details.

In general, small businesses did not perceive that many options were available for gaining information about their energy consumption. If a bill seemed high, they would deal with it through the utility company as an economic transaction. As companies got larger, analysis of energy consumption became more prevalent and companies turned to energy consultants to provide that expert analysis.

7.2 Internet Access

The direct responses to availability of Internet access given by my informants are probably no longer relevant. As noted earlier, these interviews were conducted in 1997-1999. Since then, Internet access has become much more prevalent in the United States. Broadband Internet service is now available in essentially all major metropolitan areas at a fairly nominal cost.

Nevertheless, the information my informants provided about how they would use Internet access to acquire information about energy consumption likely remains very valid. While the service availability has changed, there is nothing that would suggest that how the service is used would have changed significantly.

None of the informants reported doing a significant amount of information collection on the Internet with regard to energy consumption. The responses were consistent with the earlier general responses. Small businesses saw their energy consumption as essentially invariable. Significant changes in the utility bill were regarded as economic transaction issues, not energy consumption issues. As a result, there was nothing that would stimulate the active response necessary to seek out information on the Internet.

Medium and large business decision-makers had access to advice through personal contacts. As a result, seeking out information on the Internet was not seen as particularly valuable to them.

Based on these responses, using a Web-based system to provide comparative consumption information is therefore not likely to reach a significant number of participants. Compared to the ubiquitous and regular utility bill, Web-based information is much less likely to be relevant or effective.

7.3 Awareness of Energy Star and EPA as an Information Source

As might be expected given the above, informants did not see EPA as a source of information to which they would turn for energy advice. Awareness of the Energy Star program generally (e.g., recognition of the Energy Star logo) was low. This is another result that might be a function of the date of the interviews. In the intervening years, EPA has conducted extensive advertising campaigns to establish the “brand recognition” of Energy Star.

One significant issue that was raised by informants regardless of business size was the perception of EPA as a regulatory agency that was at best indifferent and at worst actively hostile to the needs of businesses. Not surprisingly, this perception was more prevalent in larger companies and in companies that had significant regulatory oversight. The dry cleaning companies and printing plants in particular mentioned EPA’s regulation of the chemicals used in their business operations. EPA was therefore associated with pollution regulation rather than energy efficiency.

As a result, the Energy Star symbol would not heighten the perception of information validity to these informants.

7.4 Conclusion

In sum, the view that business decision-makers took toward their utility bill had a lot to do with how they perceived the value of additional information and to whom they turned to get it. Small-business informants viewed their interaction with the utility in terms that were almost exclusively those of an economic transaction. As a result, the utility itself was the primary source of information about energy bill concerns. When a small-business decision-maker related high energy cost to potential equipment failure, repair people were seen as an alternative source of information.

Medium-sized business informants also viewed the utility as a source of transaction information. More complex tariff structures often led to confusion about the billing process. Informants from medium-sized firms were also willing to turn to outside parties for more information. In addition, outside parties were more likely to offer their services to medium-sized businesses.

Decision-makers in large firms used technical expertise, either in-house or contracted, to provide information about energy consumption alternatives. Utility companies were sometimes seen as one source for that technical expertise, but third-party consultants were mentioned more frequently.

In general, though, informants had a difficult time identifying specific sources of energy information besides the utility company. They did not seek out information from trade associations, business press, or other communication

channels. Information from sales or service representatives was often viewed with a strong degree of skepticism.

This finding reveals a significant issue for energy policy implementation with regard to “selling” energy efficiency, particularly in the small-business and mid-sized-business sectors. The main source of credible information seems to be the utility company, but the information informants seek from the utility is almost exclusively cost-based rather than consumption-based. Information provided by other parties is viewed skeptically, as the decision-makers are wary that they are being approached with a dubious business proposition. “What’s the catch” was a common response to any offer of reducing business costs, and the higher the opportunity for savings, the more skeptically the information was viewed. Much more research into who business decision-makers see as credible sources of information and how the decision-makers can best receive that information is needed to effectively advertise and implement energy information programs in the small- and mid-sized business sectors.

Chapter 8

CONCLUSION: FINDINGS AND RECOMMENDATIONS

In this chapter, I summarize the findings of the preceding chapters. I discuss general conclusions drawn from these findings. Finally, I discuss implications of these findings for future energy policy development and implementation and for future energy consumption behavior research.

8.1 Summary of Findings

Four types of business were identified. Each was distinct in the type of utility tariff it received, the size of the monthly bill, the way the decision-maker received information about the utility bill, the number of buildings or businesses over which the decision-maker had authority, and attitudes toward energy consumption.

Small, medium-sized, and hybrid business decision-makers had some interaction with the utility bill itself. Large business decision-makers often did not have access to the information provided by the utility bill; instead, they often recreated energy consumption data within their own firm through their own data collection mechanisms.

A number of informants had problems interpreting information on the utility bill correctly. I attribute their problems to the poor layout of information on the bill, combined with the presence of unnecessary information that distracted from the main message. While small-business customers typically had straightforward tariffs, many medium-sized customers had problems understanding complex tariffs, particularly demand charges. Large-business decision-makers generally understood complex tariffs and were unaffected by bill layout issues as they rarely received the utility bill.

Many decision-makers felt that energy cost reduction was difficult and unlikely to be worth significant effort to achieve. This perception, combined with the problem of incomplete comprehension of the bill's components, produced a general feeling of powerlessness among small-business decision-makers. This is, I believe, one of the most significant findings of my research. Many, even most, small-business decision-makers felt that their energy costs were not something that could be changed. As a result, they treated the bill as a cost of doing business, comparing the cost to other business expenses like rent or taxes. This perception of energy expenses as inevitable and immutable focused their attention when reading the utility bill almost solely on the dollar amount due.

This attitude also affected the interaction small-business decision-makers had with the utility company. Because they viewed the utility bill solely in dollar terms, their interactions with the utility were driven by a context of "bill as financial transaction" rather than "bill as report of energy consumption." Inquiries to the utility were then framed in this way, leading to questions about

proper charges and prices rather than questions about energy consumption and opportunities for changing energy use. As a result of this decision-making context, the idea that energy consumption was a function of behavior and that the cost of energy consumption could be significantly affected was completely lost to almost all small-business decision-makers.

Businesses that did seem interested in reducing energy consumption had managed to create mechanisms for making their consumption tangible. These decision-makers used elements of their business product to create a metric for energy consumption. These metrics were usually described in units of energy per unit of business product output.

Almost all businesses had some mechanism for filing their utility bills or, in the case of large businesses, archiving data about their energy consumption. They used these historic records to create conceptions of “appropriate” energy cost within the firm. When energy costs exceeded that appropriate range, decision-makers would first check their conception against the records to verify that the cost was unusual. Records included both prior year utility bills and energy cost budgets (which were usually based on prior year utility expenses). If the current cost was seen as unusual, the decision-maker would then turn to the utility to verify the accuracy of the transaction information. If that was determined to be accurate, some decision-makers would create hypotheses about why the cost had changed. Finally, if no extrinsic explanations for the change could be identified, the decision-maker might try to mitigate that cost change through behavioral changes.

In general, current forms of historic or self-comparison energy consumption information available on the bill were only mildly helpful, if at all, to informants. At the same time, informants expressed interest in receiving energy consumption information in a format that would be more meaningful to them. These preferences included longer time frames for historic comparison, graphical representation of the historic consumption data, and projections of future consumption based on prior trends. Self-comparison information was often overlooked or ignored on the bill due to bill layout or formatting issues. These problems with the appearance of the bill made the comparison information difficult to discern as important among all of the other bill information, much of which was seen as extraneous.

At least one utility has offered a bill that improves upon many of the drawbacks identified through interviews with informants. That improved bill provides a graphical representation of the informant's consumption information. The self-comparison is also set off clearly from the other billing information, making the information stand out distinctly.

With regard to comparative consumption information, although several examples of comparison were observed, very few informants expressed unqualified support for the idea of comparing their own energy use to the energy use of businesses like theirs. This finding was primarily because informants believed that such a comparison would be invalid. Small businesses in particular believed that their business was unique and therefore no comparable businesses existed to which they could be compared. Medium-sized businesses felt that the number of variables that would have to be controlled in order to provide a

valid comparison were too numerous to be feasible. Large businesses, while offering greater support than the other size businesses about the theoretical idea of group comparison, were skeptical that a utility would be able to collect and process the necessary data to provide the regional or national level of comparison that they would find useful.

Prior research has suggested that consumers will devalue or ignore information that is provided in a form they find confusing or challenging to their beliefs (Komor and Kempton 1991; Egan et al. 1996). Combined with these prior findings, the reactions of my informants would seem to indicate that comparative consumption information will be ineffective in the commercial sector.

This finding is tempered by the fact that no informants actually received a bill with comparative consumption information on it. It is therefore impossible to determine how business decision-makers might use such information if it were provided. Some informants, particularly hybrid business decision-makers, used information from multiple bills to evaluate the relative efficiency of the businesses receiving the bills. In short, while informants reacted against the idea of a comparison group, the impact of a comparison graphic on an actual utility bill remains unknown.

These findings are summarized by firm size in Table 8.1.

Table 8.1

Summary of Findings by Firm Size

Firm Size	Bill Comprehension Issues	Attitudes Toward Energy Cost Reduction	Mechanism for Tracking Consumption	Response to Like-Business Comparison
Small	Layout problems	Helpless, cannot change consumption	Filed utility bills	Strongly negative
	Tariff precision		Sometimes compared to residential bill	Business “unique” so no valid comparison group
	Line-item proliferation			
Medium	Small firm problems plus:	Energy consumption in business often “too complex” to be able to address	Filed utility bills	Negative, but less so than small firms
	Lack of understanding regarding demand charge		Financial statements	Complex consumption created too many variable to hold constant, making comparison invalid
	Some difficulty with TOU rates			
Large	Generally understood bill components	Generally amendable to considering options, but payback must be good	Self-created internal tracking mechanisms	Generally interested, but concerned about ability of utility to deliver useful data
	Utility bill often unavailable to decision-maker		Electronic data provided by utility	
Hybrid	Same problems as small and medium firms	Generally more amendable than small or medium	Same as small and medium	Doing some comparison already, but suspicious of utility-created comparison group

8.2 General Implications for Research and Policy Implementation

Because decision-makers in these firms often have a difficult time comprehending the information made available to them through their utility bill, they are largely opting out of the process of making energy consumption decisions based on cost. Instead, they reveal a sense of helplessness at the costs they are forced to pay, with no sense that changes in energy consumption and associated costs are possible.

It is sobering to think of this general sense of powerlessness and corresponding lack of interest in the bill in the context of today's efforts within energy policy to create new forms of energy cost structures. Sophisticated variable pricing schemes like time-of-use or critical peak pricing are likely to fall on essentially unresponsive consumers if they are implemented without attention to removing some of these comprehension barriers. Examples such as medium-sized business decision-makers who misunderstood time-of-use rates or demand charges are quite common in my data. The evidence I have presented suggests that small business decision-makers will be no better at interpreting time-of-use rates or other complicated pricing schemes. At best, the impact of "sending an accurate price signal" to small business consumers will be significantly dampened.

A similar issue is likely to occur with participants in demand response programs. Policy makers are currently examining mechanisms for involving larger numbers of customers in demand response systems. The current utility bill has been largely ignored in discussion of these demand response programs.

Business customers use their utility bills to create expectations of appropriate energy consumption. If the consumption changes that come about as a result of participation in demand response are not accurately and meaningfully reflected in the utility bill, the value the business decision-maker perceives in demand response program participation could be significantly reduced. On the other hand, integration of monthly energy consumption information with demand response information on the utility bill could create a synergistic effect, enhancing the value of information and the corresponding willingness to take energy consumption management actions.

Furthermore, the environment within which medium-sized customers would make demand response decisions has been largely ignored. My research suggests, for example, that advertising demand response programs to potential customers by showing how “businesses like yours” are already participating could be counter-productive. More information about these decision contexts is needed in order to design effective programs.

Overall, the primary information link between energy consumption behavior and cost is broken for much of the business sector. As energy policy moves toward deregulated markets, variable price environments, and dynamic consumption response systems, it becomes ever-more critical that this basic foundation of information necessary for an informed consumer to make choices in the market be repaired. Small and simple changes in the format of information on the bill can significantly reduce the opportunity for misinterpretation of the bill. That, in turn, could lead to a reduction in the apprehension and sense of powerlessness surrounding the bill and create a more informed and more active participant

in the energy market. Minor improvements in the type of data provided to commercial customers about their own energy consumption can make the information much more informative and actionable to them.

When I began this project, an underlying hypothesis used to develop my research was that business decision-makers, particularly small business decision-makers, were not significantly different from residential customers in the ways they conceived of their energy use and made choices about their energy consumption behavior. This hypothesis turned out to be largely false, particularly with regard to comparative consumption feedback. While research with the Energy Star Billing program suggested that residential customers were comfortable with the idea of being compared to like customers, small business decision-makers saw themselves as unique. Comparisons with other businesses were therefore considered invalid.

At the same time, the actions of several informants suggest that some form of comparative consumption information may be useful, despite the protests to the contrary. The primary value of comparative consumption information is the way it makes visible the potential for energy consumption reduction by demonstrating that people are already doing it. This is a powerful message. It may be that improving the information available to decision-makers on the utility bill would help persuade them that energy consumption change is possible. In such an environment, comparative consumption feedback might be regarded as more acceptable than my informants deemed it.

8.3 Specific Bill Implementation Recommendations

Beyond these general conclusions, I offer seven specific recommendations for policy implementation.

8.3.1 Displaying Meter Reading Information

As was discussed in section 4.3.2, the way information about meter reading values was presented on some utility bills caused confusion with several informants. When meter reading values are presented to show the current billing period's energy consumption, the values should be presented in a standard mathematical subtraction format such as that shown in Figure 5.2. Presenting the information in this way will improve consumer comprehension of this data.

8.3.2 Tariff Component Reporting Requirements

As discussed in section 4.3.3 and 4.3.4, the level of detail present on many utility bills about the various components of the utility's charges was overwhelming to many informants. While public utility commissions have tried to provide accurate and specific information to consumers by enumerating the variety of energy charges to a great degree of precision, the result has been reduced comprehension of the total bill. Rather than informing, these specifics end up irritating or confusing the consumer. Over time, the consumer develops the habit of ignoring that information, lumping it all together as extraneous clutter. Public utility commissions should examine bill component requirements and balance the need for accurate pricing information with the consumer's ability to absorb

information. Less information may well be more effective than more in educating the consumer.

8.3.3 Re-Examine the Demand Charge

Komor and Kempton (1991) found that none of their informants in a New Jersey shopping mall could identify the demand charge on their bill, even though the charge made up roughly half of their total bill on average. My research refines this finding - small businesses in my sample typically did not receive a demand charge as a component of the bill. Medium-sized businesses were likely to receive a demand charge. Similar to the Komor and Kempton (1991) finding, informants in businesses of this size often did not recognize or understand the demand charge. Large businesses, however, did understand it.

Combining my results with those of Komor and Kempton (1991), it seems clear that there is a substantial portion of the commercial sector for whom a demand charge is levied yet for whom the price signal of a demand charge is not received. The fact that these consumers cannot identify or adequately explain the demand charge on their bills calls into question whether this pricing mechanism is fair. It is clearly ineffective as an economic signal. Public utility commissions should re-examine the appropriateness of a demand charge to customers of this size category. As it stands, it has no public policy value other than as a revenue generation mechanism for utilities.

8.3.4 Test and Verify Consumer Comprehension

Overall, the preceding specific examples lead to a more general recommendation: public utility commissions should field-test consumer comprehension of utility bill formats and require a certain standard of comprehensibility for bills. This is essentially a “truth in labeling” issue - consumers should be able to understand what they are being required to pay. Prior research has found that policy-makers can design information displays that make a great deal of sense to policy-makers but little sense to typical consumers (Egan et al. 1996; Thorne and Egan 2002). The general confusion and irritation about utility bills expressed by informants in my research suggests that this problem may be quite widespread in utility bill information displays.

8.3.5 Require Self-Comparison Feedback

Self-comparison feedback was widely seen as useful by informants in my research. The cost of providing such data on a utility-wide scale is so low that utilities should be required to provide self-comparison information on all small and medium-sized business bills. (Since the bills are often not received by the decision-maker in large businesses, such a mandate would be less effective for large business bill recipients.) Self-comparison information should be clearly delineated on the page from other components of the bill. Graphical representation of self-comparison data is preferable.

8.3.6 Eliminate Bill Stuffers

Bill stuffers, information included on separate pieces of paper along with the utility bill in the bill envelope, were widely discarded without being read. Only a few small-business informants reported reading the stuffers. Even then, the informants reported that information available on the stuffers was not applicable to their business environment.

Utilities should eliminate bill stuffers as a mechanism for communicating with commercial sector customers, particularly larger customers. If bill stuffers are used to try to communicate with small-business customers, the information included should be targeted specifically to the business environment. For example, including information about Energy Star-qualified dishwashers has little relevance to the owner of a shoe repair store.

8.3.7 Provide Consumption Information Electronically

Informants in large businesses often reported creating their own graphical displays of consumption information as a means of tracking business energy performance and making decisions about energy efficiency investment. This was often a tedious process for decision-makers to undertake. Since they were typically not the recipients of the utility bill, it was difficult for them to acquire utility consumption information. I recommend that utilities provide electronic files containing the customer's historic consumption data for their larger business customers. This data should be provided in a common, non-proprietary format (e.g., a text file of comma-separated values) that can be easily imported to

common analysis software. One informant reported purchasing information in this format from the utility. There may be an opportunity for the utility to generate revenue and establish a closer working relationship with its larger customers by offering this service.

8.4 Specific Research Recommendations

My research revealed a number of areas in which more research could be beneficial. In addition to the recommendations about policy implementation above, I offer six specific examples of areas I believe could benefit from additional research.

8.4.1 Investigate Alternatives to Current Self-Comparison Timeframes

Self-comparison billing feedback was recognized by informants as a benefit, but a number of improvements were suggested. The time period used to provide historic comparison to customers has commonly been the monthly bill period, and the comparison is usually made with the previous month's billing period and the same billing period from the prior year. Occasionally a full thirteen-month billing history is provided.

Informants indicated an interest in time periods other than this standard monthly comparison. In particular, seasonal feedback was mentioned as an item of interest, as it corresponded more strongly with weather changes to informants. Providing feedback of longer time scales is something that, to my knowledge, has gone untested. The typical energy policy researcher would likely

consider such a long timeframe to be analytically uninteresting, as many of the variations in consumption are washed out over such a long time scale. However, the correlation with seasons and seasonal business activity may make such timeframes more accessible to business consumers. Research investigating improvements in the way self-comparison information is presented should examine this trade-off between consumption detail and consumer accessibility. Finding the optimum balance could result in more-effective self-comparison feedback.

8.4.2 Examine Effectiveness of Delivered Comparative Feedback

As mentioned in section 6.4, the results of my interview questions regarding comparative feedback were in conflict. On the one hand, some businesses reported taking actions to compare energy use across businesses, or within stores of the same business. On the other hand, small-business informants were quite negative about the validity of comparison between their business and other businesses. Research that provides actual comparative feedback data to a customer class would help reveal whether or not a consumption effect would result from such feedback. Only by providing working examples with which business decision-makers can interact will this question be resolved.

8.4.3 Explore Other Types of Business

When analyzing the data from my interviews, I noticed that the decision-making contexts of firms could be classified into four types of business. As discussed in Chapter 4 and summarized in Table 4.1, I used a number of characteristics to

identify this decision-making context and create these categories. The sample size of my research is far too small to determine whether or not these are the only categories into which businesses fall. In fact, it seems quite likely to me that there are more than four categories. Additional qualitative investigation of businesses throughout the country would help clarify business categories that could be useful from an energy policy perspective. As this research has shown, better understanding of the decision-making context can lead to suggestions for new policies and better implementation of existing policies.

One specific example of a type of business under-examined in my research is stores that are part of a national chain; e.g., Gap, Radio Shack, Wendy's, Cingular Wireless, Apple Computer, etc. The stores themselves are typically relatively small energy consumers, but the decision-making context in which energy choices are made is likely substantially different than that of a sole-proprietor's context. National chains have organizational resources on which to draw that individual small-business owners do not. Individual small-business owners may have more autonomy to make decisions about changes in operating practices and technology investment than chain-store owners do. Decision makers in these chain stores might be more willing to consider comparison with other stores of the same chain as valid (although the example of the fast food franchise owner in my research suggests otherwise.) Careful examination of this component of the business sector would provide insight that is currently lacking from energy policy decision-making.

8.4.4 Identify Trusted Sources of Information

Section 7.1 above suggested that the utility company is generally regarded by business decision-makers as a source of information that is less biased than contractors or sales people. However, the interaction between small-business decision-makers and the utility showed that the utility was viewed as a source of financial transaction information first and foremost, not a source of information about energy consumption alternatives. Section 7.3 showed that federal agencies, specifically the Environmental Protection Agency in this case, are not necessarily seen as appropriate sources of information with regard to energy consumption.

A source of information that is regarded as reliable and unbiased is critical to making decisions, particularly with regard to investment. More research on which sources of information the various commercial types see as trustworthy and accessible would be valuable to improve the effectiveness of commercial energy information/education programs.

An example of this is the Laboratories for the 21st Century (Labs21) program run by Lawrence Berkeley National Laboratory. Labs21 proposed to provide benchmark information about specific end-use information to laboratory facilities - a highly energy-intensive portion of the commercial market. The information is shared among participants, and the performance of any one participant can be compared to the benchmark performance of the other participants. As described to me by colleagues Rick Diamond and Paul Mathew in personal communications, laboratories that were approached to participate

in the program were initially concerned about revealing energy performance data that might give them a market advantage over other program participants. The combination of data anonymity and the perception of LBNL as an unbiased source of information mollified these concerns.

8.4.5 Examine Interaction Between Utility Bills and Other Utility Price/Signal Programs

Programs that can allow businesses to respond to signals from an electricity transmission authority are underway in several states. These programs are intended to allow businesses to change their energy consumption significantly when they are asked to do so. However, to my knowledge, no specific linkage is being made between the signals associated with these demand response programs and the energy information provided on the utility bill.

The utility bill provides ubiquitous, regular reporting of the energy consumption (and associated cost) of a business. Emphasizing the impact of demand response participation on the utility bill could allow participants to identify more precisely the impact of their actions. This could support program participation. Conversely, if there is no obvious link between demand response program participation and the information provided on the utility bill, the decision-maker might begin to wonder whether the response actions were actually having any effect, reducing incentive to continue program participation. Research is needed to understand the interaction between the utility bill and participation in these demand response programs within the decision-maker's energy consumption decision context.

8.4.6 Develop Better Information Displays for Complex Rate Structures Under Consideration

The deregulation of the retail electricity market has led to more-complex bill information for consumers as the cost of transmission & distribution has been separated from the cost of generation. Energy policy-makers are also investigating more-complex rate structures to try to improve the price relationship between consumption and the real-time cost of generation. Examples include various time-of-use pricing systems, critical-peak-pricing systems, etc. As these complexities are added to the retail market, it becomes more important to examine how best to convey the information to consumers. Consumers are being asked to take a much more active role in the energy marketplace. The utility bill is the primary, often sole, mechanism for communication to these consumers about the relationship between their market decisions and their energy costs. If energy policy is meant to encourage active retail decision-making of electricity consumption, we must provide the decision-makers with clear, comprehensible information they can use to make those choices.

8.4.7 Examine Impact of Better Utility Bill on Energy Consumption Attitudes and Behaviors

As has been discussed earlier, small-business informants reported a strong sense of helplessness and powerlessness with regard to changing the energy consumption of their businesses. I believe that the lack of understanding of the current utility bill was a significant factor in the development of these attitudes

toward energy consumption. As a result of these attitudes, small-business decision-makers were less likely to take actions that would reduce their energy consumption.

The impact of utility bill comprehension on attitudes toward utility energy efficiency programs targeted toward small commercial customers has never been empirically examined. A research program should be developed that (a) uses the insights gained from this dissertation to develop utility bill information that is more readily comprehensible to the consumer, and (b) tests the impact of this improved bill on small-business consumer attitudes toward energy efficiency and conservation programs. It is my hypothesis that better utility bill information will ultimately lead to greater interest and involvement in programs that encourage energy consumption reduction through conservation or efficiency measures.

8.5 Final Thoughts

Based on my research, small and medium-sized businesses have only a tenuous conceptual connection between their energy consumption behavior and their energy costs. While prior energy policy research has identified issues such as split incentives, transaction costs, and the relative lack of consideration given to energy costs compared to other aspects of running a business, the issues of information comprehension that I have discussed have been largely overlooked or ignored. I believe a significant portion of this oversight can be attributed to the lack of data about the energy consumption decision-making context within such firms. Qualitative methods are very useful in collecting this data, and more

research using these techniques is needed within firms of all sizes to develop the rich understanding such data provides. Such understanding will provide policy makers with a more-complete understanding by which to develop and implement efficient and effective solutions to the energy and environmental policy problems facing us today.

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Appendix A

INTERVIEW PROTOCOL

I began the interview process by introducing myself as a student doing research on energy consumption in the business sector. If an appointment had not already been established, I would ask to speak with the person at the business who received the utility bill and made decisions about energy use. Once that person was identified, I would ask if I could talk with them for 15-30 minutes about their utility bill, how they used it, and what they thought about energy use in their business.

All informants were informed that their participation was completely voluntary, that they could end the interview at any time, and that any responses they provided would be anonymous in descriptions of my research.

No data on personal information about the informants was collected.

When conditions allowed, a tape recorder was used to record the interview. Informants were asked if recording of the conversation was permitted and told that notes of the conversation would be taken if taping was not desired.

After that introduction, the following questions were used to guide the interview:

Do you receive a utility bill?

What all comes in the envelope? Can we take a look at it together?

Can you lead me through the process you go through when you get the bill?

(Go over portions of the bill and ask about specific elements)

What does this mean to you? How do you use it?

What other information do you get about your energy use? (Magazines/
newsletters, consultants, Internet?)

How important to you is reducing your energy bill?

Would it be helpful to you to be able to compare your energy use:

(a) with your use from last month?

(b) with your use from this month last year?

(c) with other businesses like yours?

(d) with other businesses in the same area (if applicable)?

(e) with some other comparison type? (What would that be?)

If you were to receive a bill that showed you were using more energy in the comparison above, what would you do? What if you were using less energy?

Would you be willing to pay for a bill that showed you these comparisons? How much would you be willing to pay?

If you wanted to know more about your energy use, where would you look for that information?

Have you heard about the Energy Star Program?

Do you have Internet access?

Thank you for taking the time to speak with me today. May i have a copy of your utility bill for my records? You may black out any of your contact information on the bill.

[End interview]

Appendix B
LIST OF INFORMANTS

1. Shoe repair store (12/97 - CA)
2. Health food store (12/97 – CA)
3. Grocery store (12/97 – CA)
4. Dry cleaner (12/97 – CA)
5. Fast-food franchise (5/98 – NJ)
6. Ice cream store (8/98 – DC)
7. Private school (9/98 – CA)
8. Printer (9/98 – CA)
9. Psychologist (9/98 - CA)
10. Lawyer (9/98 – CA)
11. Church (9/98 – CA)
12. Dentist (9/98 – CA)
13. Furniture store (9/98 – CA)
14. Mortgage banker (9/98 – CA)
15. Wood stove store (9/98 – CA)
16. Hotel (9/98 – CA)
17. Manufacturer (10/98 – MA)
18. Manufacturer (10/98 – MA)

19. Hospital (10/98 – IL)
20. Manufacturer (10/98 – IL)
21. Bike store (12/98 – DC)
22. Liquor store (1/99 – DC)
23. Printer (1/99 – MD)
24. Printer (1/99 – MD)
25. Day-care center (1/99 – VA)
26. Gift shop (1/99 – VA)
27. Martial arts school (1/99 – VA)
28. Private School (1/99 – VA)
29. Auto repair (1/99 – VA)
30. Auto repair (1/99 – VA)
31. Grocery store (1/99 – VA)
32. Restaurant (1/99 – OH)
33. Hardware Store (1/99 – OH)
34. Retirement Community (1/99 – OH)
35. Barbershop (1/99 – OH)
36. Manufacturer (2/99 – VT)
37. Health food store (2/99 – VT)
38. Bakery (2/99 – NY)
39. Insurance company (2/99 - VT)
40. Manufacturer (2/99 – VT)
41. Municipality (2/99 – VT)

42. College (2/99 – VT)

43. Fitness center (2/99 – VT)

44. University (2/99 – VA)